CITROEN BX AND PEUGEOT 405

Marelli-Solex I.A.S. Central Injection System

This new type of engine management involves central injection which employs dynamic ignition (with distributor and individual coil) in the case of the XU engine, but, on the other hand, static ignition (no distributor, with twin coil) for the XU-10M engine.

In both versions, injection and ignition are controlled by a single control unit.

The system also features self-diagnosis and a limp-home program.

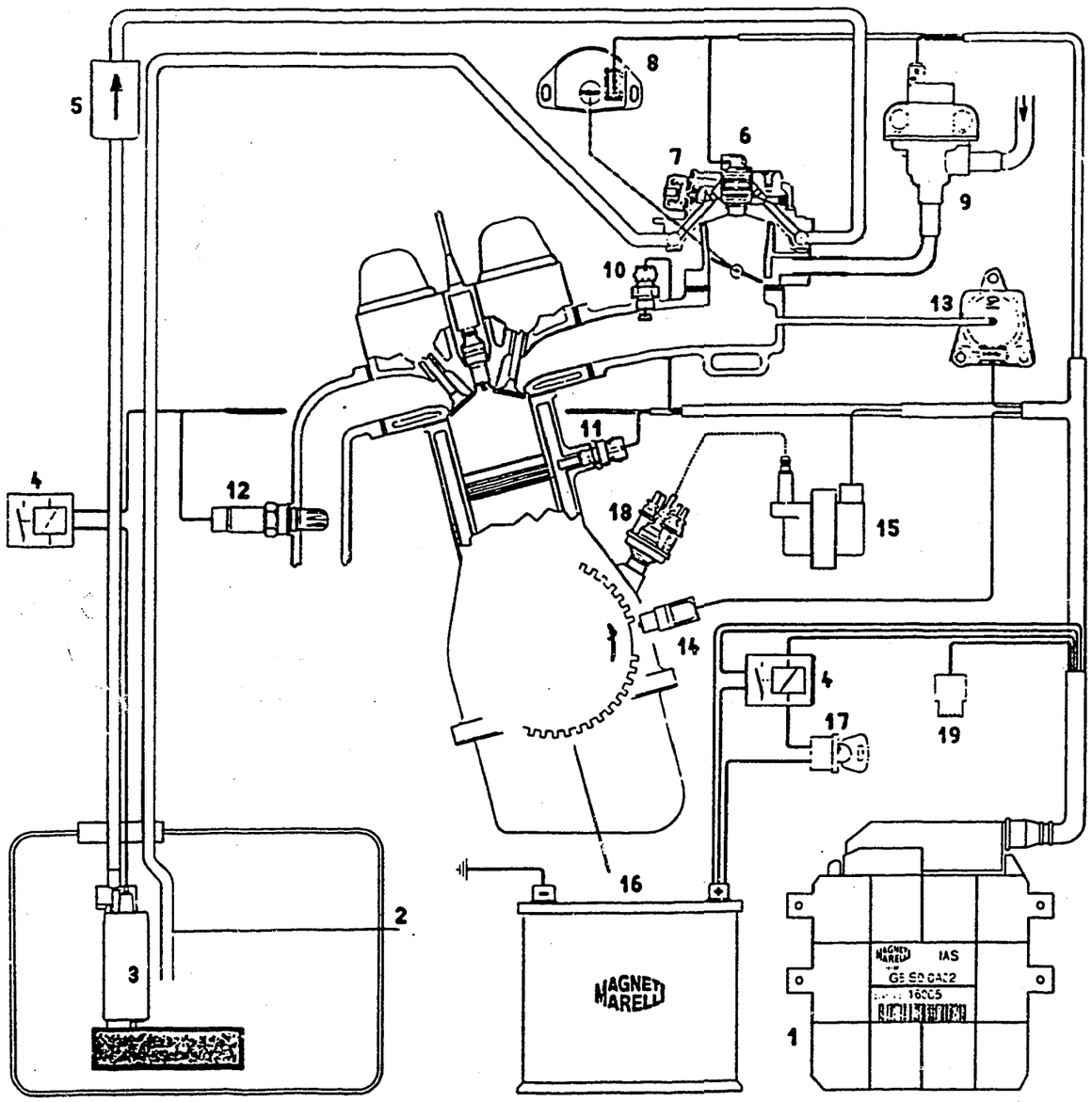
1. Design and function

The schematic representation of the complete I.A.S. injection system with integrated ignition system (refer to Coordinate 03/04) provides information on the system design.
The quantity of fuel injected is determined by the opening time of the injection valve. This valve is subject to a constant pressure of 0.8 bar. The basic injection time is calculated by the control unit on the basis of information from the pressure sensor (load condition) and the rev counter (engine speed). By employing signals from other sensors, the control unit can prepare a correction map with which the basic values are matched to the instantaneous operating condition of the engine.
The built-in self-diagnosis system outputs stored faults in the form of a code.
For readout purposes, a light-emitting diode - which is combined with a switch - is to be connected to the vehicle diagnosis socket.

1.1 The individual components

The fuel pump can be installed in the tank or in the fuel line in the immediate vicinity of the tank.
The delivery rate of the fuel pump is 1.5 l/min. given a fuel pressure of 0.8 bar and a battery voltage of 13.5 V
The fuel filter contains a paper element with a surface area of 3000 cm^2 which is capable of retaining particles with a diameter of 8...10 thousands of a millimeter.
The throttle-body injection unit consists of two parts. The bottom part accommodates the throttle valve and the throttle-valve potentiometer, whereas the upper part houses the fuel-pressure regulator and the injection valve.

- The throttle-valve potentiometer acts on the one hand as idle/full-load contact switch, and, on the other hand, as a sensor for detecting the exact valve position at part load. The potentiometer is supplied with 5 V by the control unit and transmits signals back the control unit relating to the potentiometer resistance (throttle-valve position).



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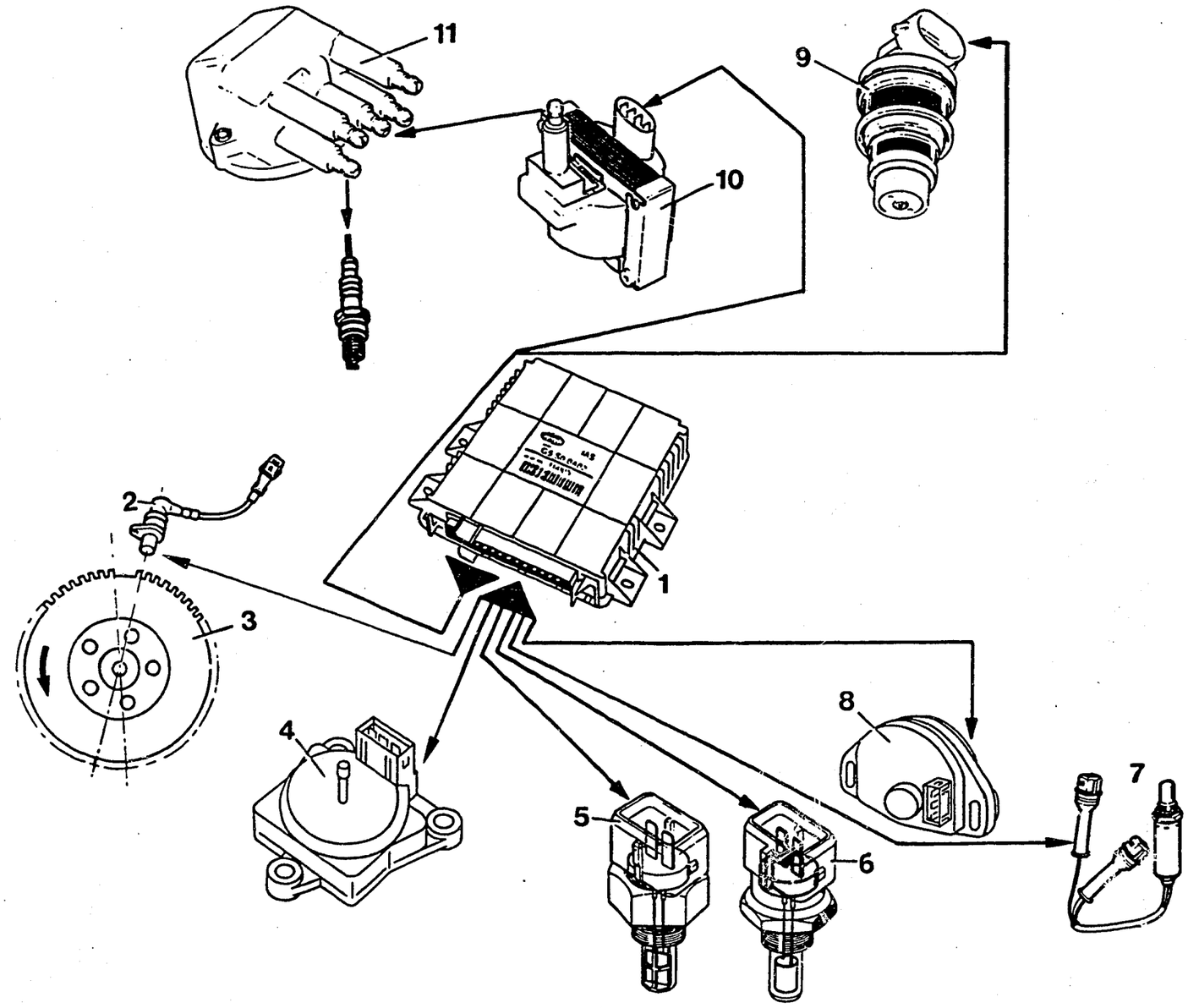
Schematic representation of complete I.A.S injection system with integrated ignition system

1 = Control unit
2 = Fuel tank
3 = Fuel pump
4 = Fuel-pump relay
5 = Filter
6 = Injection valve
7 = Pressure regulator
8 = Throttle-valve potentiometer
9 = Idle-speed regulation valve
10 = Mixture-temperature sensor
11 = Coolant-temperature sensor
12 = Lambda sensor
13 = Pressure sensor
14 = TDC and eng.-speed sensor
15 = Ignition coil
16 = Battery
17 = Ignition switch
18 = Ignition distributor
19 = Diagnosis plug



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The most important individual components with signal generators of the I.A.S injection system with ignition system

1 = Control unit
2 = Engine-speed and TDC sensor
3 = Flywheel with pulse ring gear
4 = Intake-manifold sensor
5 = Mixture-temperature sensor
6 = Coolant-temperature sensor
7 = Lambda sensor
8 = Throttle-valve potentiometer
9 = Injection valve
10 = Ignition coil
11 = H.T. distributor

- The fuel-pressure regulator, which is bolted to the top part of the injection housing, provides a constant system pressure of 0.8 bar. It operates together with a diaphragm and a balanced spring.
- The injection valve is supplied with voltage by the control unit as a function of the engine operating status. Special conditions apply on operating the starting motor. The amount of fuel injected is then solely dependent on the coolant temperature.

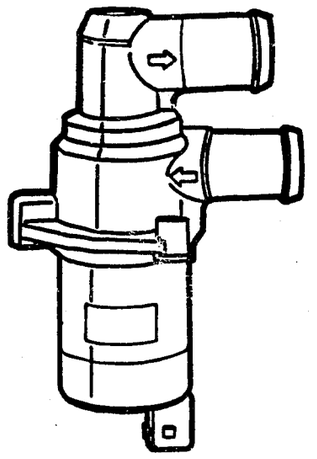
The idling-speed regulation valve consists of an electric motor and a piston which regulates the air bypass. The valve has three functions:

- As throttle-valve closing delay, it helps to improve emission behaviour and running comfort when the engine is in overrun.

- During cold starting and in the course of the warm-up phase, it acts in the same manner as the auxiliary-air device in conventional systems by supplying the engine with the auxiliary air required for smooth running.

- Given a change in load, such as that occurring when switching in auxiliary units, the valve has a stabilizing effect which helps to keep the idling speed constant.

The piezoelectric pressure sensor records the pressures in the intake manifold. The control unit uses its signals as load information. Furthermore, the barometer function makes for automatic altitude correction.
The TDC and position sensor is an induction sensor. The TDC mark takes the form of a tooth space in the flywheel ring gear. The sensor likewise recognizes the engine speed on the basis of the frequency of the induced signals.
The mixture-temperature sensor is located in the intake manifold. As an NTC sensor, its resistance decreases with increasing temperature.
The coolant-temperature sensor is also an NTC sensor. This sensor determines the temperatures in the cylinder head.
Monitoring of the correct mixture for vehicles with a catalytic converter is effected by a lambda sensor. Its function is the same as that encountered in other injection systems.
The control unit receives the necessary information from the sensors outlined above and regulates the various final control elements on the basis of these signals. Its main tasks are to determine the injection time and the in-phase start of injection. It is also responsible for calculating the optimum ignition point. Additional tasks are fuel-pump control, fuel-vapor return, providing information for the vehicle computer and idle-speed regulation. The fault memory and limp-home program are also handled by the control unit.



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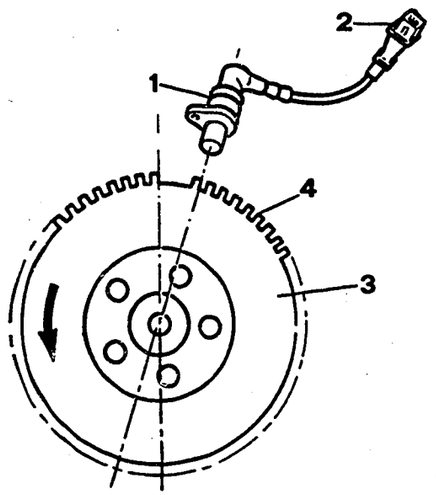
Idle-speed regulation valve

1 = Sensor
2 = Plug connection
3 = Flywheel
4 = Pulse ring gear



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2. Tests and adjustments

2.1 Safety precautions

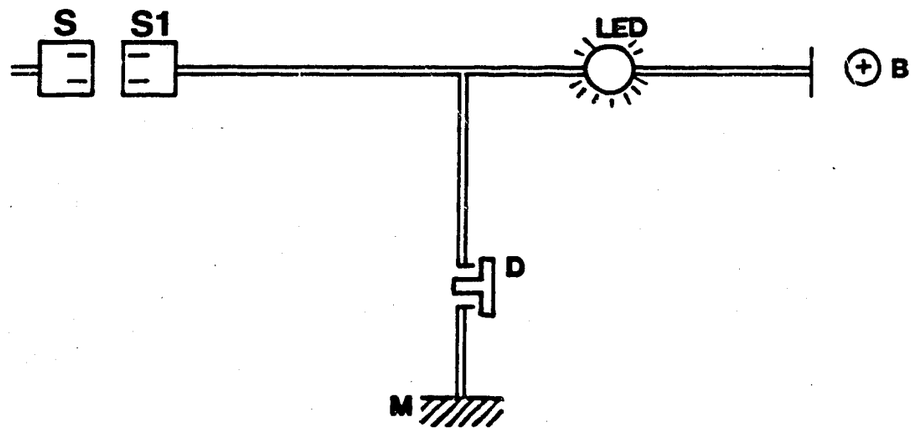
a) On electrical system

- The battery is never to be disconnected with the engine running and a voltage of 12V should not be exceeded when providing starting aid.

- The control unit is to be detached or removed when carrying out electric welding work or stoving work at temperatures in excess of 80°.

- Use is not to be made of indicator lamps when checking the electrical system.

b) When working on the fuel system, welding, polishing and smoking in the vicinity are prohibited.
If the fuel supply line is disconnected, the pressure in the system is to be carefully dissipated; this is done by placing a rag around the line on detaching it, so as to catch the fuel which squirts out.



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B = Battery +

G = Ground

2.2 Testers and tools

For interrogating the self-diagnosis, use is to be made of a small tester which can be user-manufactured as shown.
It consists of a plug (S1), which is connected to the diagnosis plug (S) in the vehicle, a pushbutton switch (D) and an LED.

Testing the sensors and cable connections only requires standard high-impedance voltmeters and ohmmeters, as well as a vacuum and pressure gauge, and a rev counter.

N o t e :

The ignition is always to be switched off before disconnecting and connecting plug contacts!

2.3 General system testing

Testing can be performed on the basis of the trouble-shooting table (refer to Coordinate 25). A check should however be made beforehand to ensure that battery, starting motor, spark plugs and air filter are in proper working order.

a) The faults stored in the control unit can be read out with the aid of the user-manufactured tester.

To effect code readout, the plug is first to be connected to the diagnosis connection so that the LED lights up.

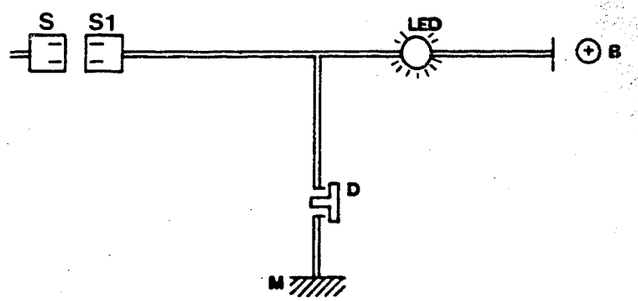
If the ignition is then switched on, the LED goes out and the warning lamp in the instrument panel lights up.

In order to initiate code output, press the button for five seconds. Shortly afterwards, the LED flashes up "1 2" (bottom picture) which represents the start symbol and not a code.

The first fault code does not appear until the button has been pressed again.

Each time the button is then pressed the next stored fault is called up. This process is continued until the control unit and LED indicate by way of the symbol "1 1" that the end of the list has been reached.

The fault memory cannot be cleared until the code "1 1" has appeared, the warning lamp in the instrument panel has gone out and defective components have been replaced.



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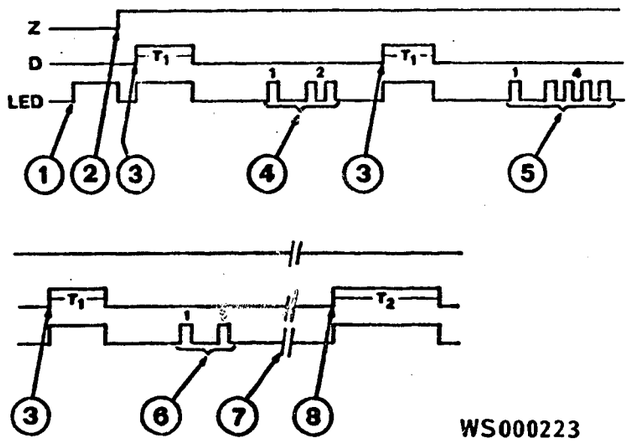
Z = Ignition switch
D = Pushbutton
LED = Light-emitting diode
1 = Connection of tester to diagnosis plug
2 = Switch-on of ignition, LED goes out
3 = Pushbutton actuation
4 = Flashing code "1 2" (entry into fault-code output)
5 = Flashing code "1 4" (table!)
6 = Code "1 1", completion signal
7 = Repair phase
8 = Clearing of fault memory
T1 = 5 seconds
T2 = 10 – 20 seconds



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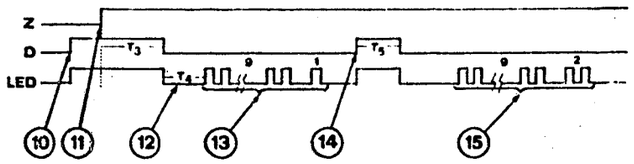
b) An additional test program comprises automatic testing of the important final control elements. The top picture indicates the test sequence:

The main relay (1st final control element, refer to table on Coordinate 27) is tested automatically after a period of between 1 and 12 s (t 4) during which the ignition is switched on and the pushbutton pressed as well as a 3.6 s phase (t 5).

Testing lasts roughly 30 seconds.

The next test procedure is initiated by pressing the button (5 s).

Testing is terminated by switching off the ignition.



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10 = Pushbutton, LED on
11 = Ignition on
12 = Time span prior to automatic start of testing
13 = Code "9 1" (main relay)
14 = Call-up of next final control element by pressing pushbutton
15 = Code "9 2" (injection valve)
T3 = 1 – 12 seconds
T4 = 3.6 seconds
T5 = 5 seconds

c) The limp-home program provides the following substitute values should a sensor fail:

Coolant temperature	Start with intake-air-temperature value, then 1° C increase per 200 engine revolutions (up to 90° C). If intake-air-temperature sensor also defective: assumption 90° C (fixed).
Intake-air-temperature sensor	Substitute value = 50° C
Pressure sensor	Substitute value, atmospheric pressure = 1013 mbar. Substitute value, intake-manifold pressure calculated from map (throttle-valve position, engine speed). In the event of defective throttle-valve potentiometer: Assumption 450 mbar.
Throttle-valve potentiometer	Assumption "idle" at pressures < 300 mbar, "part load" (throttle valve half open) at pressures in excess of 300 mbar.

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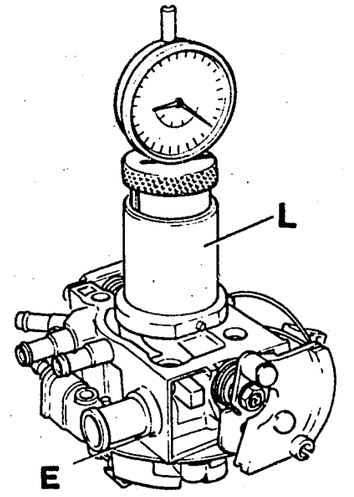
2.4 Idling speed and ignition point

Neither the idling speed nor the mixture composition can be altered. Basic adjustment of the throttle valve (see top picture) is however possible with the injection unit disassembled by employing the familiar Solex protractor used for carburetor repair.

There is no ignition-point adjustment in the conventional sense. It is however possible to effect correction. When performing adjustment, the control unit is influenced with the user-manufactured tester. In order to gain access to the program, the plug connection is to be attached, the button pressed and the ignition switched on. After a period of between 1 and 12 seconds, the button should be released for a maximum of 3.6 seconds and then pressed again twice for 5 seconds. (Refer to bottom picture). The LED indicates "2 2" by way of confirmation.

The actual adjustment is performed in increments or decrements of 2° in each case. An increment is provided by pressing the button once, a decrement by pressing it twice. The LED then indicates the adjustment by way of the codes "1 1" (= 1 x 2°), "1 2" (= 2 X 2°), "1 3" (= 3 x 2°), "1 4" (= 4 x 2°, maximum adjustment) and "1 9" (no adjustment). The altered value is stored by pressing the button (10 – 20 s). Once the storage procedure has been completed, the LED confirms the alteration with the code "1 1".



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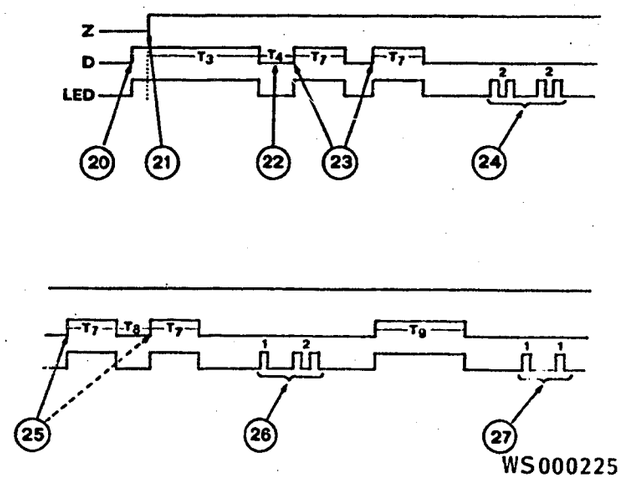
L= Solex throttle-valve protractor

Correction of ignition point

20 = Press of button, LED on
21 = Ignition on
22 = Max. time period prior to pressing of pushbutton
23 = 2 x pressing of button
24 = Code "2 2" (confirmation of entry procedure)
25 = 1 x (increment) or 2 x (decrement) pressing of button
26 = Adjustment message, code "1 2" (refer to text)
27 = Storage confirmation with code "1 1"

T3 = 1 – 12 seconds
T6 = < 3.6 seconds
T7 = 5 seconds
T8 = < 5 seconds
T9 = 10 – 20 seconds



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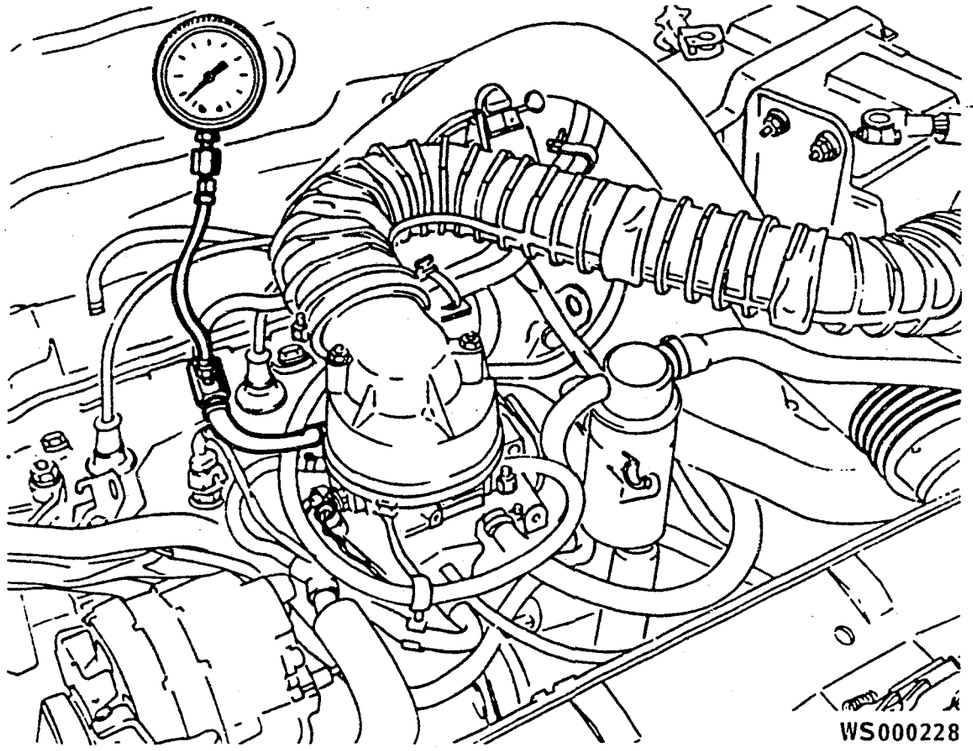

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3. Testing of individual components

3.1 System pressure test

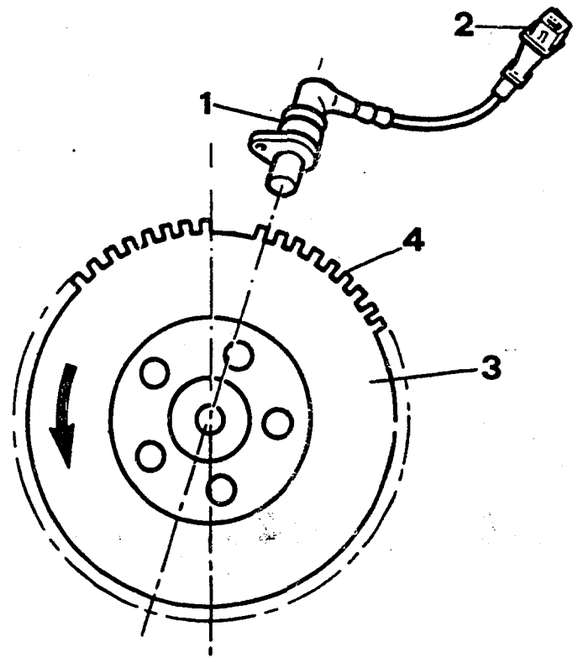
The test is to be performed at idle with the engine running.

If the engine doesn't run, remove the fuel-pump relay and jumper the plug connection. The pressure gauge is connected up immediately upstream of the connection at the injection housing.

Set value: 0.8 ± 0.1 bar.

If the pressure is not sufficient, the fuel pump or pressure regulator may be defective.

If the pressure is too high, the pressure regulator or the return line may be defective.



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3.2 Fuel-pump delivery

For test purposes, the fuel-pump relay is to be jumpered and a hose is to be connected up to the return connection and suspended over a suitable graduate. Given full battery voltage, the pump must provide at least 1.5 l of fuel per minute.

3.3 Engine-speed and TDC sensor

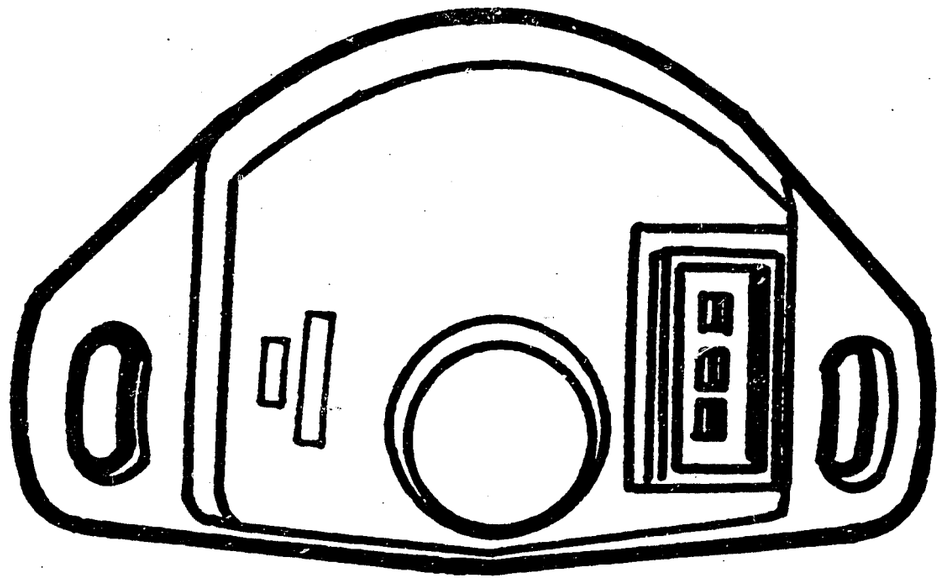
If a voltmeter with millivolt scale is connected up to the plug (top picture), it must be possible to measure voltage pulses of between 0.3...0.5 V there when the starting motor is operated.

3.4 Mixture and coolant-temperature sensor

These NTC resistors are to be checked in a water bath using an ohmmeter.

The set values are indicated in the table below.

Coolant temperature (°C)	Sensor resistance (Ω)
– 10	8,200 ... 11,000
20	2,280 ... 2,720
80	290 ... 370
Mixture temperature (°C)	**Sensor resistance (Ω)**
10	265 ... 285
20	280 ... 300
30	295 ... 315



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3.5 Throttle-valve potentiometer

A voltage of 5 V must be applied to the supply terminal.

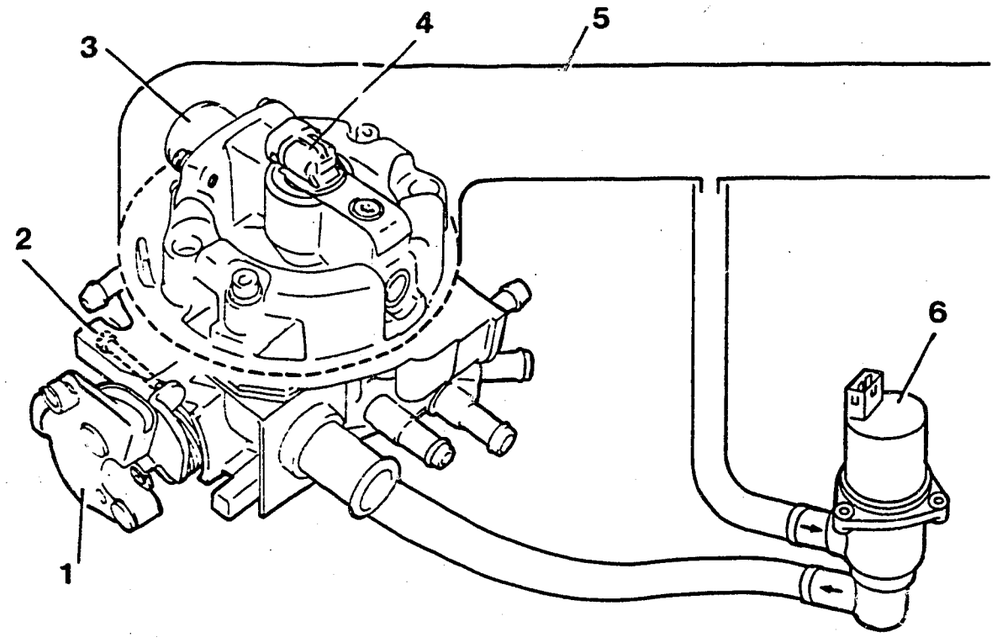
On performing resistance measurement, there must be a considerable change in resistance between idle and full-load stop (from 2...3 k Ω to 6...10 k Ω).

3.6 Intake-manifold-pressure sensor

At atmospheric pressure, a voltage of 5 V must be applied to the power supply terminal.

If a vacuum pump is attached to the vacuum connection, the voltage at the output terminal must alter with increasing vacuum (drop in voltage).

The voltage should still be approximately 2.0 V at 500 mbar.



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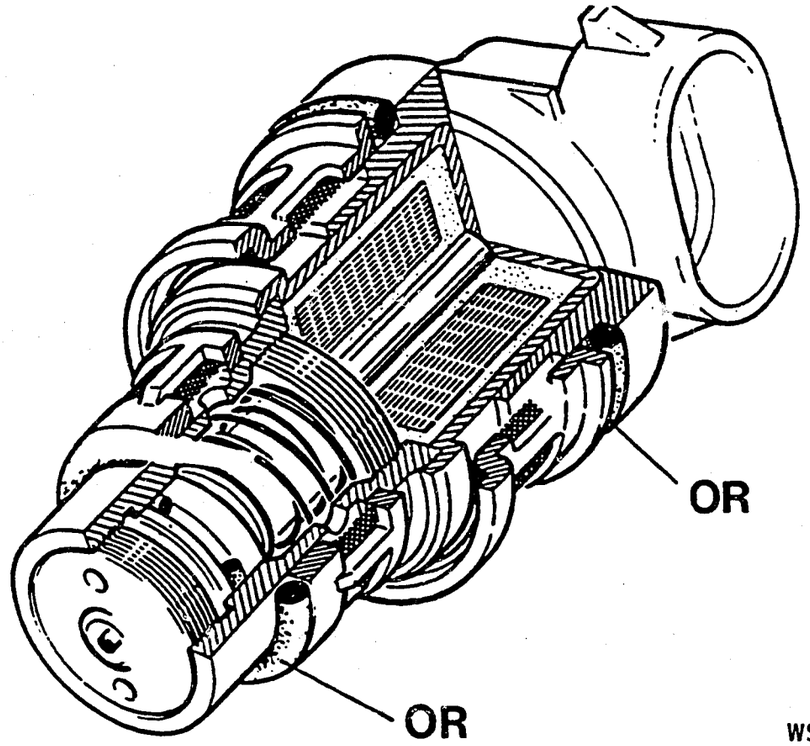
1 = Throttle-plate lever
2 = Throttle-valve stop screw
3 = Pressure regulator
4 = Injection valve
5 = Air guide tube
6 = Idle-speed regulation valve

3.7 Idle-speed regulation valve

A voltage of at least 9 V must be applied to its terminal.

The resistances between the terminals are:
17...25 Ω



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OR = O-rings

3.8 Injection valve

In the event of contamination, the injection valve can be removed after loosening the bracket and cleaned for example in a nozzle-cleaning unit. The O-rings (OR) are to be renewed when re-installing.
The minimum operating voltage of the injection valve must be 9 V. The solenoid winding must have an internal resistance of
1.5 ± 0.25 Ω .

Proper, cone-shaped valve injection can be checked through the air inlet opening with the air filter removed and the engine running. It is possible to precisely observe the spray pattern if use is made of a timing light.

The injection valve is to be renewed in the event of poor atomization.

Table I – Trouble-shooting

Engine fails to start or starts only with difficulty (cold and/or warm)	Engine starts but then dies	Inadequate high idle speed (cold engine)	Rough or excessive idle (engine warm)	Misfiring during acceleration	Lack of power	Excessive consumption	Check and if necessary replace
X	X	X		X			Air and fuel system lines
X	X			X			Supply voltage of fuel pump
X	X		X	X		X	Fuel pressure
			X	X			Fuel supply
					X		Throttle-valve basic adjustment
X	X	X	X				Idle-speed regulation valve
X	X	X		X		X	Coolant-temperature sensor
						X	Mixture-temperature sensor
X							Injection valve
	X	X	X			X	Pressure sensor
X							TDC and engine-speed sensor
			X		X		Setting of accelerator pedal
X							Power supply of control unit
			X	X	X	X	Throttle-valve potentiometer
	X		X				Freedom from leaks of air system
X	X	X	X	X	X		Electrical test at connections of control-unit plug
X	X		X		X	X	Compression
X	X	X	X	X	X	X	Control unit

Table II – List of fault codes

Code	Defective component	Warning lamp
54	Control unit	on
14	Coolant–temperature sensor	on
13	Mixture–temperature sensor	on
33	Pressure sensor	on
21	Throttle–valve potentiometer	on
41	TDC and engine–speed sensor	on
42	Injection valve	on
45,47	Ignition coil, dynamic ignition	on
45	Ignition coil 1, static ignition	on
57	Ignition coil 2, static ignition	on
22	Idle–speed regulation valve	on
52,31	Mixture composition	on

Testing of final control elements

Code	Final control element tested
91	Main relay
92	Injection valve
93	Idle–speed regulation valve
94	Solenoid valve, fuel–vapor monitoring system
95	Relay, air conditioner

Technical data

Central injection system	I.A.S, Solex–Marelli
Model series	Citroen BX Peugeot 405 GLi; 605
Engine type	XU–5M; XU–10M
Capacity (cm3)	1580; 1998
Max. power (kW)/rated speed (min^{1})	65/6000; 94/5600
Max. torque (Nm)/engine speed (min^{1})	128/3100; 175/4800
Valve clearance, cold (mm), inlet	0.15
outlet	0.25
System pressure (bar)	0.8 ± 0.1
Idling speed (min^{1})	850 ± 50
Engine–speed limitation	none
Injection valve	
Resistance	1.5 ± 0.25 Ω
Operating voltage	9...13 V
Supply pump:	
Delivery at	13.5 V = 1.5 l/min
Exhaust–gas check values – CO	< 0.4 (vol. %)
measured downstream of – HC	< 100 (ppm)
catalytic converter. – CO2	> 12 (vol. %)
Not adjustable!	
Ignition	integrated
Ignition coil	forms power unit together with trigger box
Resistance of primary winding	0.7 (Ω)
Resistance of secondary winding	6600 (Ω)
Spark plugs – Champion	C9YCX
– Eyquem	FC52LS
Electrode gap	0.8 (mm)
Tightening torque	17 ... 18 (Nm)

FENIX IB ELECTRONIC CENTRAL INJECTION SYSTEM in Citroen BX, Peugeot 309 and Peugeot 405, installed in 1.9 l gasoline engine, type XU 9.

The above engines have been fitted since 1988 with the central injection system developed by Solex and Bendix. In terms of power, the catalytic converter XU 9M.DDZ engine ranks between the carburetor and multipoint versions with the same capacity. A characteristic feature is the combination of the injection and ignition control in a joint control unit from Bendix. The sensors and final control elements used are produced by various manufacturers.

Design and function

Despite the fact that the system is controlled by a single central control unit, and although the individual elements exert mutual influence, it is nevertheless possible to distinguish between three groups:

Injection system
The supply of fuel is handled by a electric roller-cell pump which is located in or in the vicinity of the fuel tank depending on the vehicle concerned. The fuel passes through a fuel filter into the throttle-body injection unit where the pressure regulator limits the fuel pressure to 0.8 bar.

This low pressure level minimizes the outlay required for keeping the pressure system free from leaks.
In order to avoid starting problems, the fuel pump starts to operate for a period of 1.5 seconds on switching on the ignition. The pump is switched off again if the engine does not start. The fact that the pressure regulator is located downstream of the injection valve provides the desired flushing effect in the pressure system which is a particular advantage in the event of a warm start.

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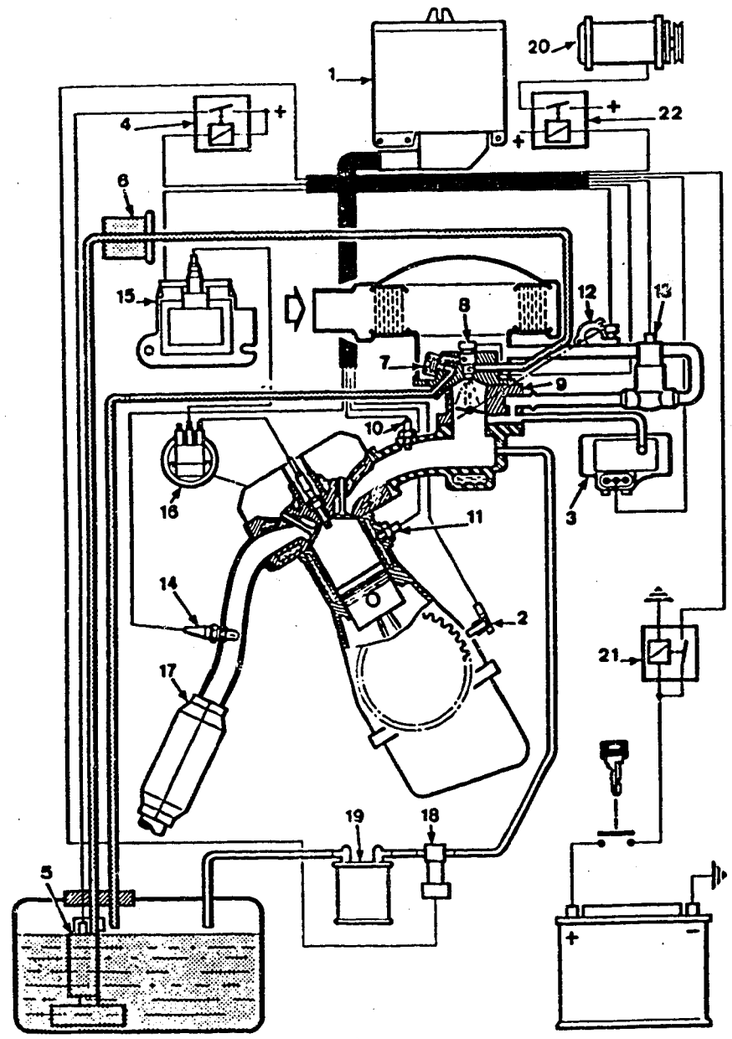

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Overview of Fenix injection and ignition system

1 = Control unit
2 = Engine-speed and TDC sensor
3 = Intake-manifold-pressure sensor
4 = Fuel-pump relay
5 = Fuel-pump *)
6 = Fuel filter
7 = Fuel pressure regulator
8 = Injection valve
9 = Throttle-body injection unit
10 = Mixture-temperature sensor
11 = Coolant-temperature sensor
12 = Throttle-valve potentiometer
13 = Idle actuator
14 = Lambda sensor
15 = Ignition-power unit
16 = H.T. distributor
17 = Catalytic converter
18 = Vent valve
19 = Active-carbon container
20 = A/C compressor
21 = Main relay
22 = Relay for A/C control

*) for Citroen BX and Peugeot 405; outside tank.

The electromagnetic injection valve is located in the top part of the throttle-body injection unit.

During the time period calculated by the control unit, this valve atomizes and injects fuel into the intake manifold. The quantity of fuel injected is governed solely by the opening time of the injection valve, since the pressure of 0.8 bar is kept constant by the pressure regulator.

The two main sources of information for determining the injection time are the engine-speed and TDC sensor as well as the intake-manifold-pressure sensor, which is connected by means of a hose to the intake manifold and which converts the pressure information into an electric signal by means of a piezo-element.

The basic time period calculated in this manner is corrected on the basis of further sensor information (mixture temperature, coolant temperature, position of throttle valve, Lambda sensor).

The injection valve is actuated twice per crankshaft revolution.

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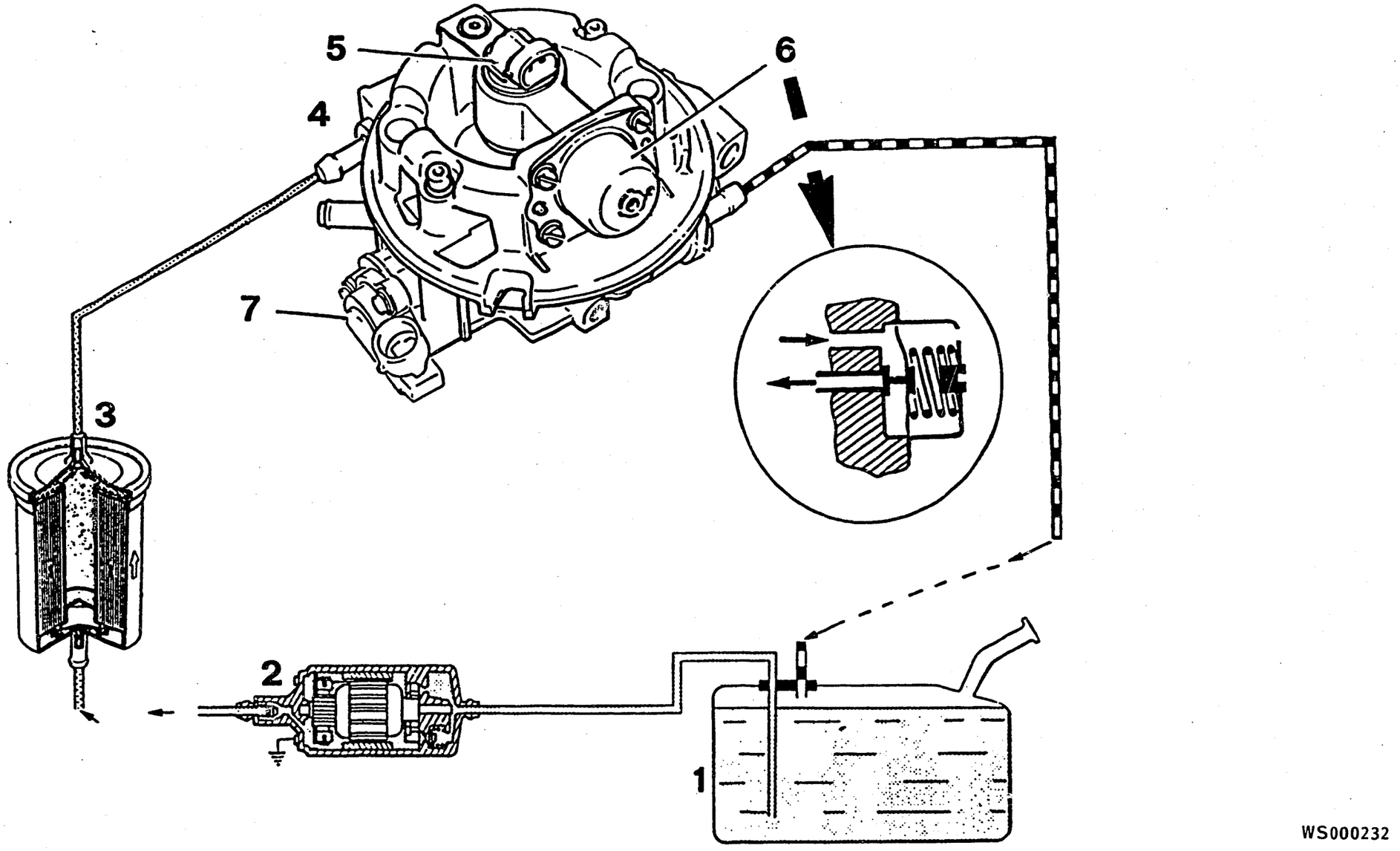

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Injection system of Fenix system

1 = Fuel tank
2 = Fuel pump
3 = Fuel filter
4 = Throttle-body injection unit
5 = Injection valve
6 = Pressure regulator
7 = Throttle-valve potentiometer

The idle actuator provides compensation for changes in operating status, with the result that the idling speed remains constant. The throttle valve and the throttle-valve potentiometer are located in the bottom part of the throttle-body injection unit. A crescent-shaped opening prevents the acccumulation of fuel when the throttle-valve is closed.

The throttle-valve potentiometer provides the control unit with information on the engine load condition.

If a sensor does not provide any signals or if the control unit does not consider them to be plausible, mean values are used as substitute values within the framework of the limp-home-program.

Ignition system

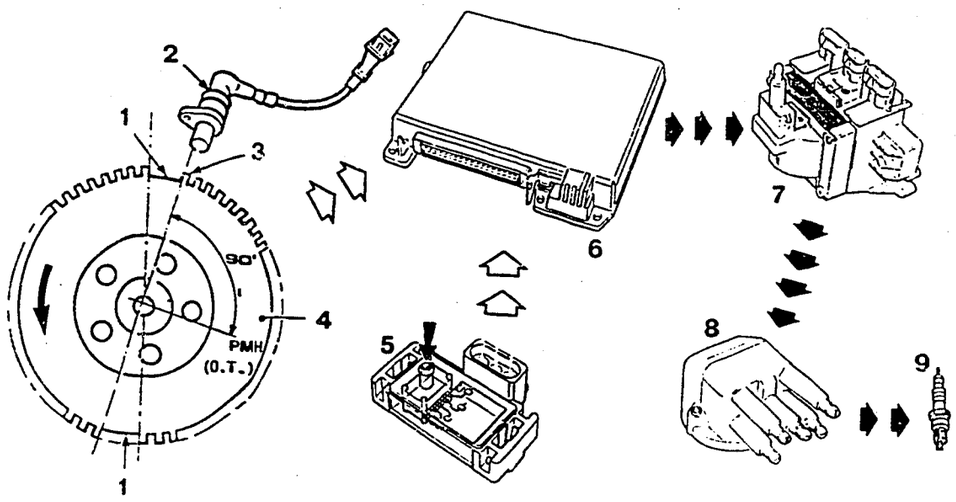
The ignition points as a function of load and engine speed are stored in the control unit in the form of a map.

The comparatively rough bacic network of 117 points is "honed" on the basis of the signals provided by the correction sensors already mentioned.

The power unit is actuated directly by the control unit.

The map as well as the engine-speed and TDC sensor obviate the need for a pick-up coil in the ignition distributor, with the result that the latter is merely responsible for distributing the high voltage to the individual cylinders.

The ignition point cannot be adjusted.



WS000233

Ignition section of Fenix system

1 = Tooth gaps
2 = TDC and engine-speed sensor
3 = Tooth flank which triggers pulse
4 = Flywheel
5 = Intake-manifold-pressure sensor with vacuum connections (arrow)
6 = Control unit
7 = Ignition power unit
8 = H.T. distributor
9 = Spark plug

The ignition point is calculated by the control unit on the basis of the map and with the aid of the engine-speed and TDC sensor with 40 teeth distributed around the periphery of the flywheel. Two opposite tooth gaps mark the 90° before TDC positions of the crankshaft. These are then precisely given when the tooth (3) and the inductive pick-up are opposite one another.

Emission control system

In addition to the catalytic converter, the emission control system features a fuel-vapor monitoring system. With this system, a vent valve is located between the active-carbon container and the intake manifold. This valve is kept open or closed by the control unit as a function of the engine operating status.

Safety precautions to be taken prior to performing work on the fuel system.

If the fuel system is to be opened up, welding, polishing and smoking are prohibited in the vicinity. Before loosening fuel lines and hoses, the system is to be carefully depressurized. This is done by wrapping a rag around the line connection before loosening it, so as to catch the fuel which sprays out.

Testers and tools

The system is designed such that all tests can be performed without the need for special measuring instruments. All that is required are a standard high-impedance voltmeters and ohmmeters, a vacuum gage, a pressure gage and a rev counter. The Solex throttle-valve protractor is needed for carrying out adjustments to the throttle valve.

Pre-checks

The Fenix systems does not have a self-diagnosis facility. In the event of problems, use is to be made of the trouble-shooting table on Coordinate 13/14.

A check is however to be made beforehand as to whether the vehicle battery, starting motor, ignition system and air filter are in proper working order.

Table A – Trouble-shooting

Engine fails to start or starts only with difficulty (cold/warm)	Engine starts but then dies	Inadequate high idle speed with cold engine	Rough or excessive idle with warm engine	Engine does not maintain idle speed	Misfiring during acceleration	Lack of power	Excessive fuel consumption	Considerable smoke generation in all engine-speed ranges	Tests to be performed
X	X	X	X	X		X		X	Visual inspection of air and fuel system lines
X	X					X			Check on supply voltage of fuel pump
X	X				X	X	X	X	System pressure check
					X	X			Fuel delivery check
			X						Check on throttle-valve basic adjustment
X	X	X	X	X					Check on idle-speed regulation valve
X	X	X			X		X	X	Check on engine-temperature sensor
							X		Check on air-temperature sensor
X									Check on injection valve
	X	X	X	X			X	X	Check on pressure sensor
X									Check on engine-speed sensor
			X			X			Check on setting of accelerator pedal
X									Check on power supply of electronic control unit
			X		X	X	X		Check on throttle-valve potentiometer
	X		X	X					Check on air system pressure
X	X	X	X	X	X	X		X	Testing of control-unit plug terminals
X	X		X	X		X	X	X	Compression check
X	X	X	X		X	X	X	X	Test with new control unit

System pressure check (0.8 bar must to be measured)

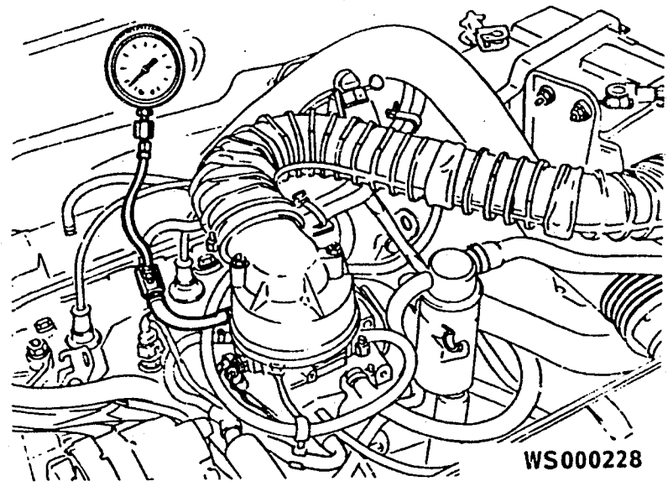
The pressure gauge is positioned in the supply lines immediately upstream of the throttle-body injection unit (see picture). If the engine is functional, the check is to be performed at idle. If the engine won't run, the fuel-pump relay is to be removed and the plug connection jumpered. If the pressure is less than 0.7 bar, the distinction is to be made between two situations after shutting off the return line:

a) Pressure less than 1.1 bar
   Fuel pump defective or problem with power supply (partial open-circuit or loose contact).
b) Pressure in excess of 1.1 bar
   Pressure regulator defective.

If the system pressure is more than 0.9 bar, a line to a graduate is to be connected up in place of the return hose. The distinction is again to be made between two situations:

a) Pressure between 0.7 and 0.9 bar
   Return hose clogged or defective.
b) Pressure in excess of 0.9 bar
   Pressure regulator defective.

The pressure regulator cannot be replaced on its own. If necessary, the entire top part of the injection unit, which is attached to the throttle-valve section with four bolts, must be renewed.

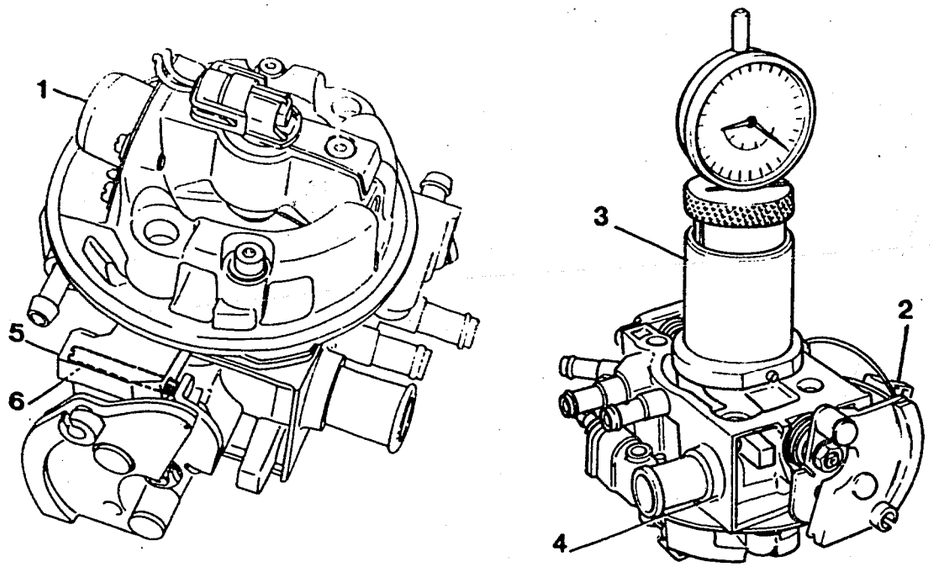


Checking delivery

To do so, connect a line to a graduate in place of the return hose and then operate the fuel pump by jumpering the relay connector. Given a mimimum of 12 V battery voltage, the fuel pump must supply at least 370 ccm of fuel in 15 seconds. If this is not the case, the pump is to be renewed or the leads are to checked for voltage loss.

Idle-speed adjustment

Neither the idle speed nor the mixture composition can be altered. In event of deviations from the set values, a system test must be performed in accordance with Table A and the Section entitled "Checking sensors and final control elements".



WS000300

Adjustment of throttle-valve closing angle

1 = Pressure regulator
2 = Power supply of injection valve
3 = Solex throttle-valve measuring instrument
4 = Injection unit
5 = Cap
6 = Stop screw
Throttle-valve basic adjustment

The basic adjustment of the throttle-valve angle must be 7° 20′ ± 45′. This value can be determined with the injection unit disassembled using a Solex throttle-valve measuring instrument as used for carburetor adjustment work. Correction can be effected by means of the stop screw 6 (see picture). A check is also to be made to ensure that the throttle-valve is neither resinous nor sticking.

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Checking sensors and final control elements

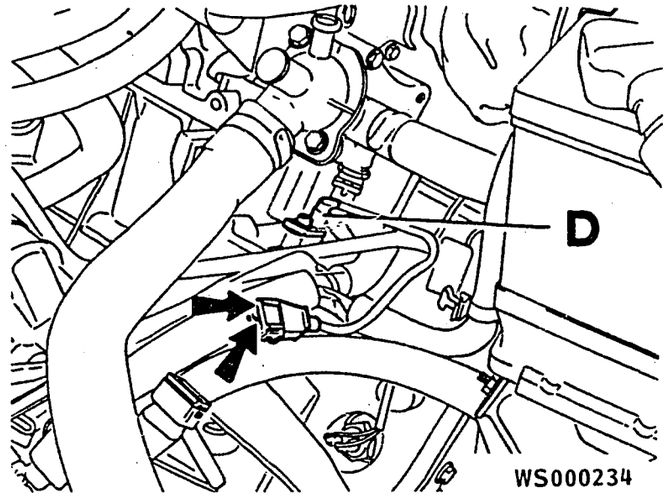
The engine-speed and TDC sensor (top picture) is tested at its terminals using a voltmeter. The voltage must be 0.4 V when the starting motor is operated.

Check intake-manifold-pressure sensor for correct voltage supply.

With the ignition switched on, approx. 5 V must be applied between connections A and C (bottom picture).

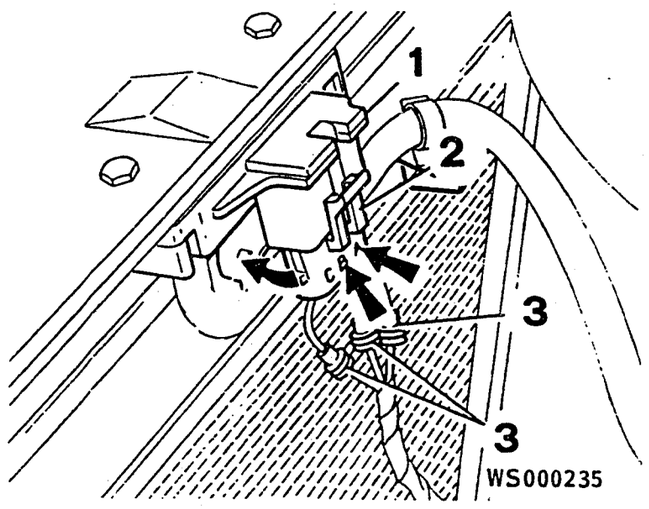
If this is not the case, the lead from the control unit (term. 16) is to be checked.
The voltage is then to be tested between connections A and B with differing degrees of vacuum.

At atmospheric pressure, it must be approx. 5 V; given a negative pressure of 250 mbar, which is to be applied using a hand pump, the figure should be approx. 3.4 V or roughly 2 V in the case of 500 mbar vacuum. If this is not the case, the intake-manifold pressure sensor is to be renewed.



Resistance measurement between the connections marked with arrows

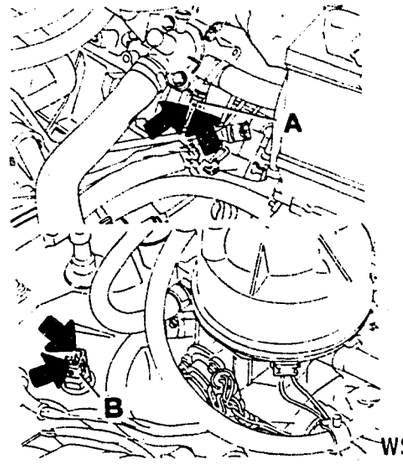
1 = Intake-manifold-pressure sensor
2 = Plug
3 = Detached seals



The coolant and mixture-temperature sensors are NTC/PTC resistors which are to be checked in a water bath using an ohmmeter. Their resistance changes as a function of temperature as follows:

Coolant temperature (°C)	Sensor resistance Ohms
– 10	8200 ... 11000
20	2280 ... 2720
80	290 ... 370

Mixture temperature (°C)	Sensor resistance Ohms
10	265 ... 285
20	280 ... 300
30	295 ... 315



Position of coolant-temperature sensor (A) and mixture-temperature sensor (B).

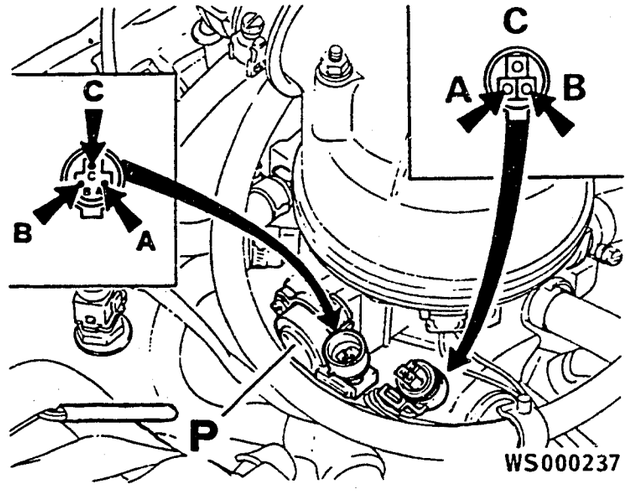
With the ignition switched on, the throttle-valve potentiometer must be provided with a voltage of approx. 5 V between terminals A and B (bottom picture). If this is not the case, the lead from the control unit (term 16) is again to be checked.

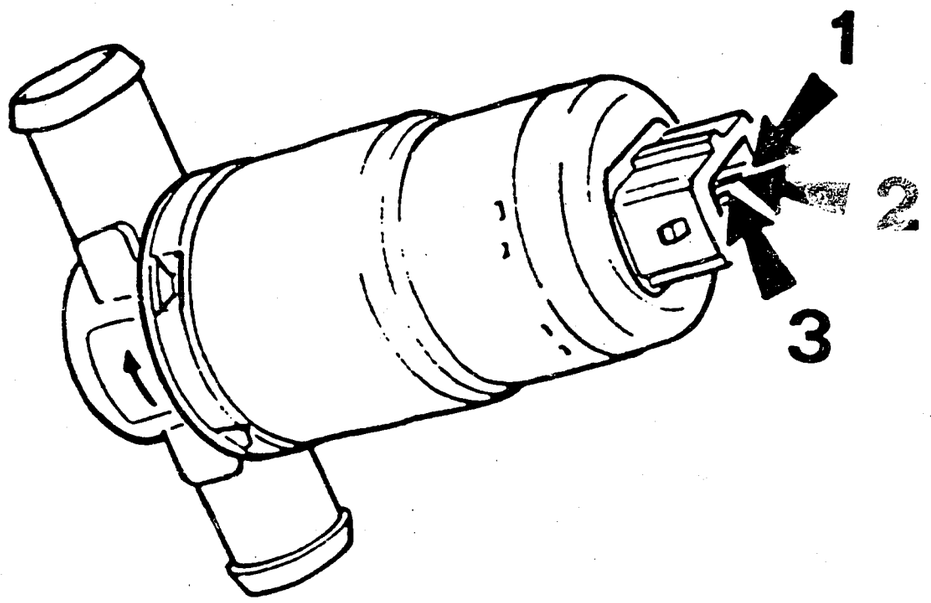
The resistance between A and B must be in the range between 6 and 10 Ω . If connections B and C are connected using an ohmmeter, it is possible to check the idle and full-load points (idle = 18...3100 Ω , full load = 6500 ...11000).

The supply voltage of the injection valve must not be less than 9 V. If this voltage is not attained, the connections and the lead from term. 21 at the control unit are to be tested.

The resistance of the injection valve is 1.5 ± 0.25 Ω . If the valve is defective, the entire top part of the injection unit must be renewed.

The testing of the supply voltage at connector (right) and resistances in idle and full-load position at throttle-valve potentiometer (P)





WS000238

The idle-speed regulation valve must likewise be provided with an operating voltage of at least 9 V.

If necessary, check connections and lead from control unit (term. 23/24).

Resistance measurement:

between term. 1 and 2 19...25 Ω

between term. 2 and 3 = 17...22 Ω

Visual inspections

Once the air filter has been disassembled, it is possible to closely observe the proper injection and atomization of the fuel at the nozzle opening.

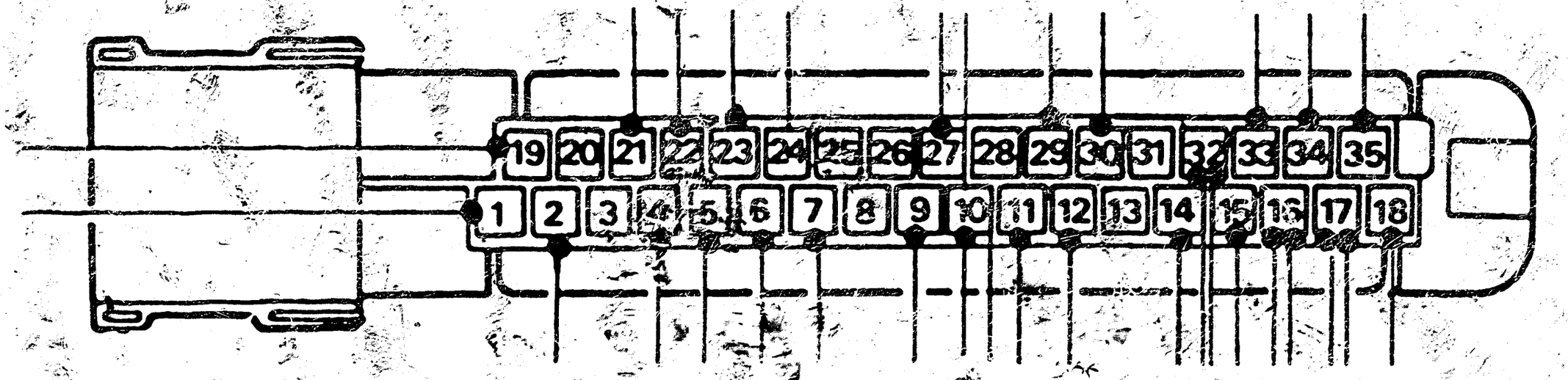
The spray pattern, which should be cone-shaped, can be carefully inspected with the aid of a timing light directed into the air inlet opening of the injection housing.

Control unit

The control unit is located between the two engine bulkheads. If the control unit is thought to be defective, the 32-pole plug is to be detached and the unit removed. The plug contacts are first to be checked for corrosion and cleaned if necessary.

A proper ground connection (term 1 and 2) is likewise extremely important.

If all connection points are O.K., but there is still a fault present, try using a replacement unit.



CONNECTIONS OF CONTROL-UNIT PLUG

WS000240

1/2= Ground
4 = Power supply
Continous voltage
5 = Relay, A/C compressor
6 = Fuel-pump relay
7 = Injection relay
9 = Throttle-valve potentiometer
10 = Shielding, engine-speed sensor and Lambda sensor
11 = Engine-speed sensor
12 = Selector-lever position (automatic) or ground (manual)
14 = Intake-air-temperature sensor
15 = Coolant-temperature sensor
16/16A = + Pressure sensor
= + Throttle-valve-potentiometer
17/17A = - Pressure sensor
= - Throttle-valve-potentiometer
18 = Diagnosis connection not used
19 = Voltage supply after ignition switch
= Injection valve
22 = Solenoid valve of fuel-vapor monitoring system
23/24 = Idle-speed regulation valve
27 = Ignition-power unit
29 = Starting motor
30 = ECO button of air conditioner
32/32A = Ground; air-temperature sensor and coolant-temperature sensor
33 = Pressure sensor
34 = Thermostat, air-conditioner
35 = Lamda sensor

Ignition

The ignition point cannot be adjusted.
The ignition system can however be checked for correct voltage supply as shown on the next Coordinate. The set values for the measure points U1, U2 and U3 are as follows: 12...13, i.e. battery voltage; for U4 = > 0 V.

Once the power unit has been disassembled (coil and trigger box separated), it is possible to check the primary resistance (approx. 0.7 Ω) and the secondary resistance (approx. 4,800 Ω) as well at the ignition coil.

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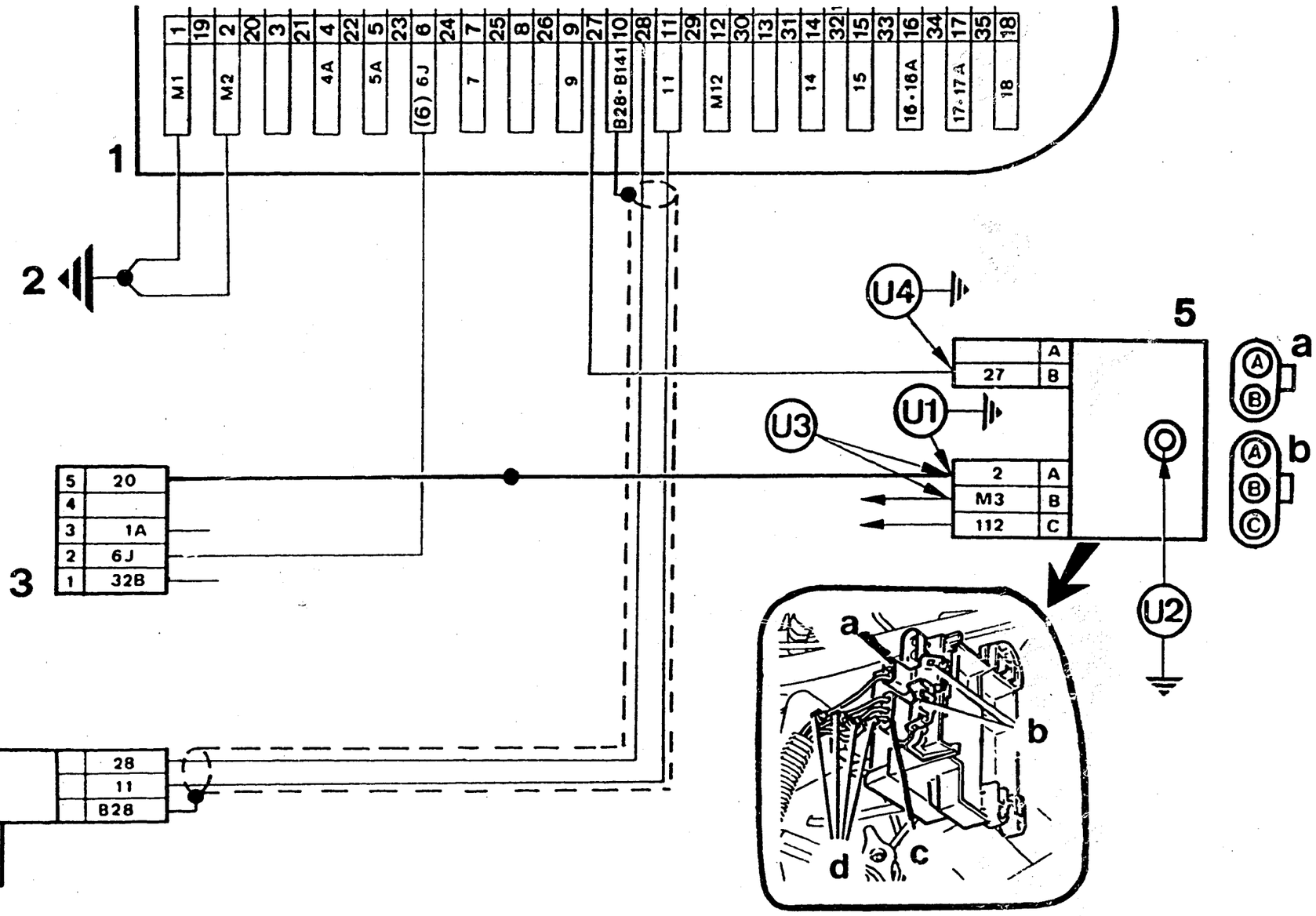

WS000239

Schematic representation of ignition system

1 = Control unit
2 = Ground
3 = Supply relay
4 = Engine-speed and TDC sensor
5 = Ignition-power unit with insert

a = Plug
b = Caps
c = Plug
d = Detached seals

Technical data

Central injection system		Fenix 1B
Model series		Citroen BX Peugeot 309 and 405
Engine type		XU9M.DDZ
Capacity (cm3)		1905
Max. power (kW)/rated speed (1/min)		80/6,000
Max. torque (Nm)/engine speed (1/min)		158/3,000
Valve clearance, cold	Inlet Outlet	0.20 ± 0.05 mm 0.40 ± 0.05 mm
System pressure		0.8 ± 0.1 bar
Idle speed		850 ± 50 1/min
Engine-speed limitation		none
Injection valve	- Resistance	1.5 ± 0.25 Ω
	- Operating voltage	9...13 V
Supply pump	- Delivery 12 V	= > 370 ccm in 15s
Exhaust-gas check values measured dowmstream of catalytic converter. Not adjustable!	- CO	< 0.4 (vol.-%)
	- HC	< 100 (ppm)
	- Co2	> 12 (vol.-%)
Ignition		integrated
Ignition coil		forms power unit together with trigger box.
Resistance of primary winding		0.7 Ω
Resistance of secondary winding		4,800 Ω
Spark plugs	- Champion	C9YCX
	- Eyquem	FC52LS
Electrode gap		0.8 (mm)
Tightening torque		27 ... 28 (Nm)

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

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IGNITION SYSTEM

Peugeot 205 GT, XT (engine type K2A TU 3S)

1. Design and mode of operation

The electronic ignition system (Ducellier) consists of an ignition distributor with inductive pickup (possibly also Hall trigger), an electronic trigger box and a high-performance ignition coil.

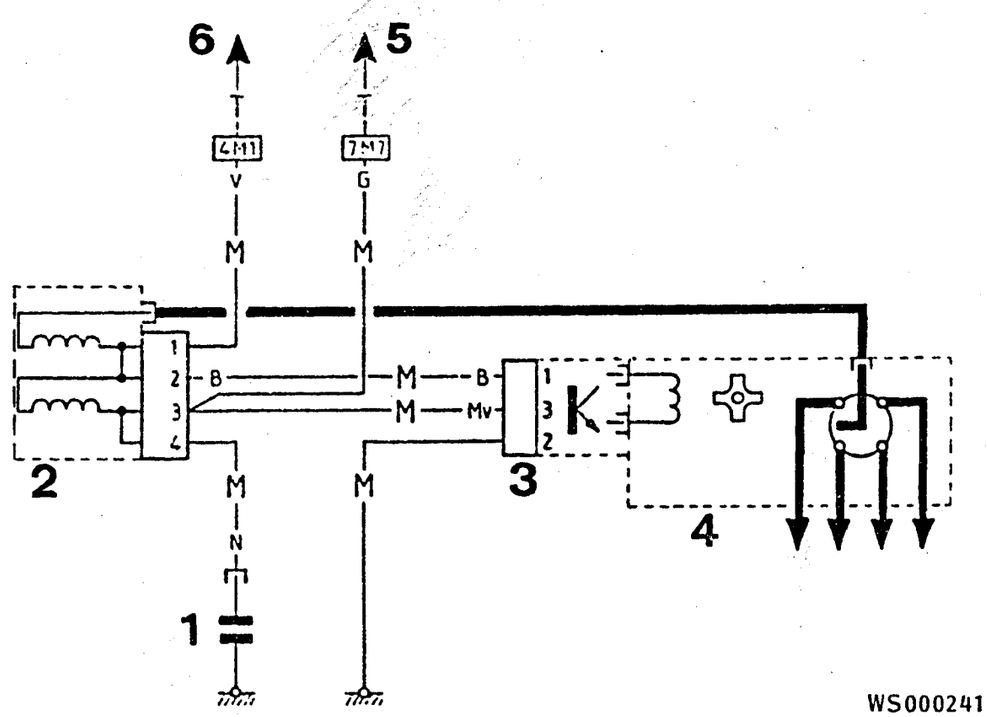
The ignition distributor of the Peugeot TU 3S features mechanical centrifugal advance and vacuum advance by means of a vacuum unit. The electronic trigger box is positioned on the ignition distributor, the housing of which makes for trigger-box heat dissipation.

The high-performance ignition coil is located on a mount above the trigger box. The ignition distributor is driven directly by the camshaft and is installed horizontally.

Mode of operation: The magnetic pulse generator, which consists of a stator with inductive coil positioned on the setting plate and a likewise 4-pole rotor located on the distributor shaft, produces a small a.c. voltage as the engine is cranked.

This voltage, which is directly dependent on engine speed, is processed in the trigger box in such a manner that the primary current flowing into the ignition coil can be switched on and off with it.

The trigger box likewise features peak-coil-current cutoff which interrupts the flow of current to the ignition coil as soon as the engine stops for more than 1.5 s.



1 = Battery
2 = Ignition coil
3 = Trigger box
4 = Ignition distributor with pulse generator
5 = to ignition lock
6 = to rev counter

Schematic view of electronic ignition system

2. Testers

Voltmeter and ohmmeter, rev counter, vacuum pump with pressure gauge and ignition coil.

3. Trouble-shooting and elimination of faults

First consecutively check the following

- The battery voltage which must be at least 11 V.
- The voltage at the + terminal of the ignition coil which must correspond to the battery voltage. If this is not the case, there is an interruption in the supply of current to the ignition coil.
- The voltage between the + and − terminals of the ignition coil must be 0. If any voltage can be measured, there is a short to ground either in the trigger box or in connecting cable 3 which is routed from the ignition coil to the trigger box.
- The voltage at terminal 3 of the trigger box must correspond to the battery voltage. If this is not the case, there is an open-circuit in the cable between ignition coil and trigger box.

3.1 Testing of individual components

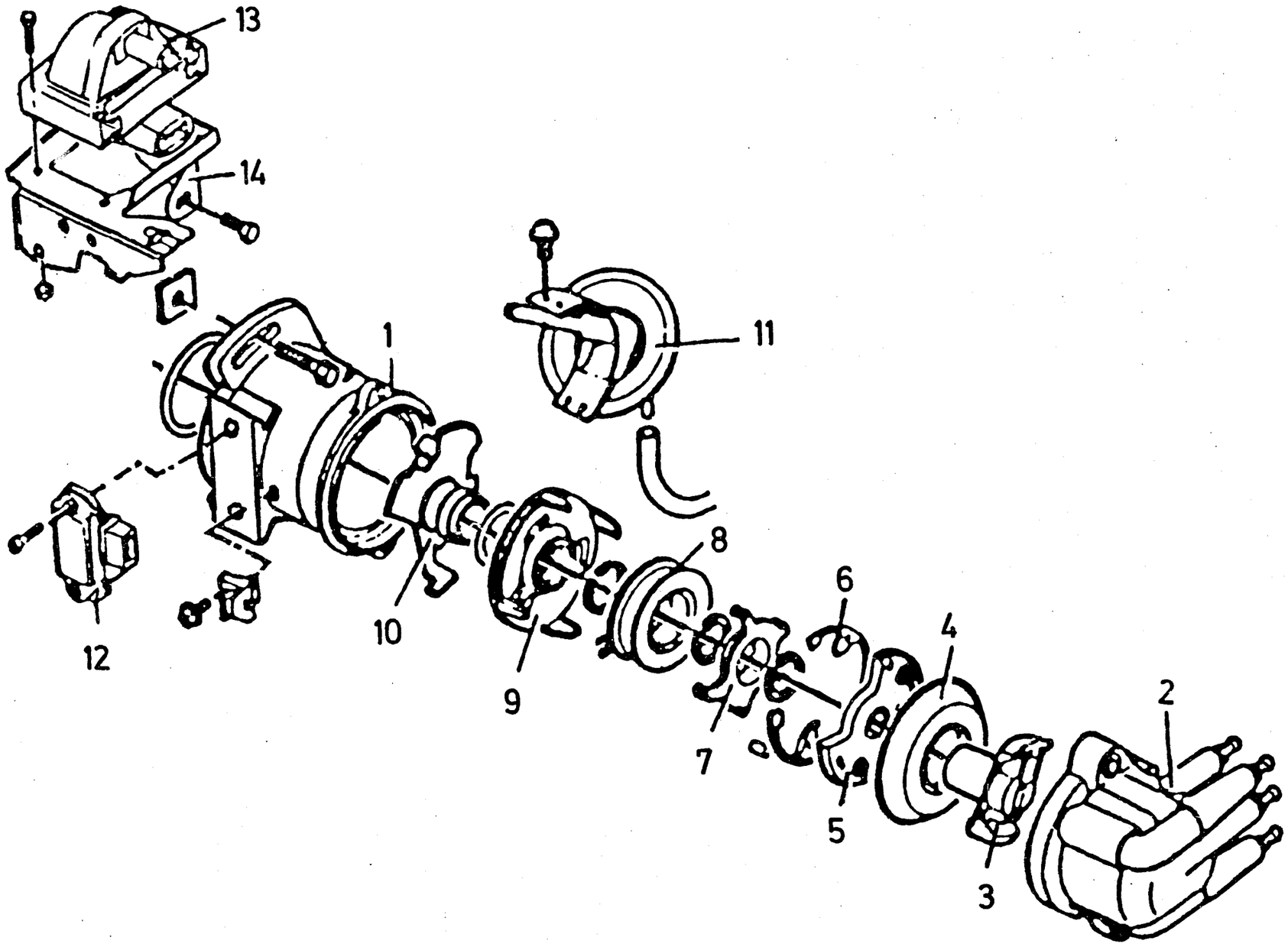
a) The following are to be tested at the ignition coil with the plug detached

- the primary resistance – it should be 0.7 Ω
- the secondary resistance – it should be 6 k Ω and
- the insulation of the ignition coil with respect to ground.

b) The following measurements are to be taken at the magnetic pulse generator after removing the plug at the trigger box:

- An ohmmeter connected between the terminals of the generator coil should give a reading of 300 Ω .
- The resistance between the connections of the generator coil and ground should be infinity Ω .

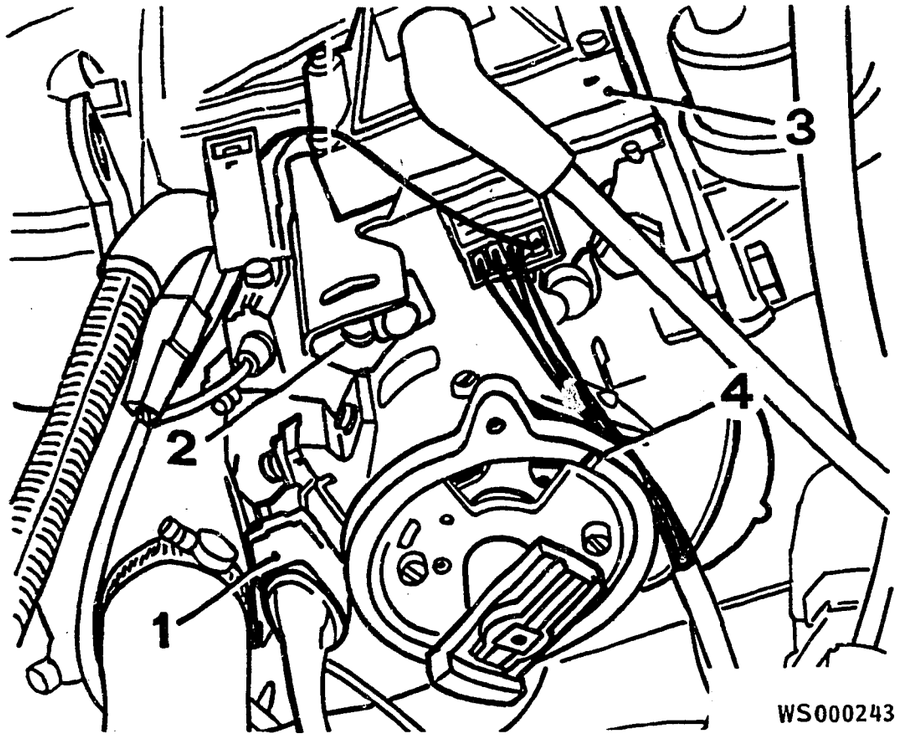
c) The trigger box is to be checked with an ohmmeter for good ground connection (resistance 0 Ω). It is only to be replaced if all other components have been checked and found to be in order.



WS000242

INDIVIDUAL COMPONENTS OF IGNITION DISTRIBUTOR

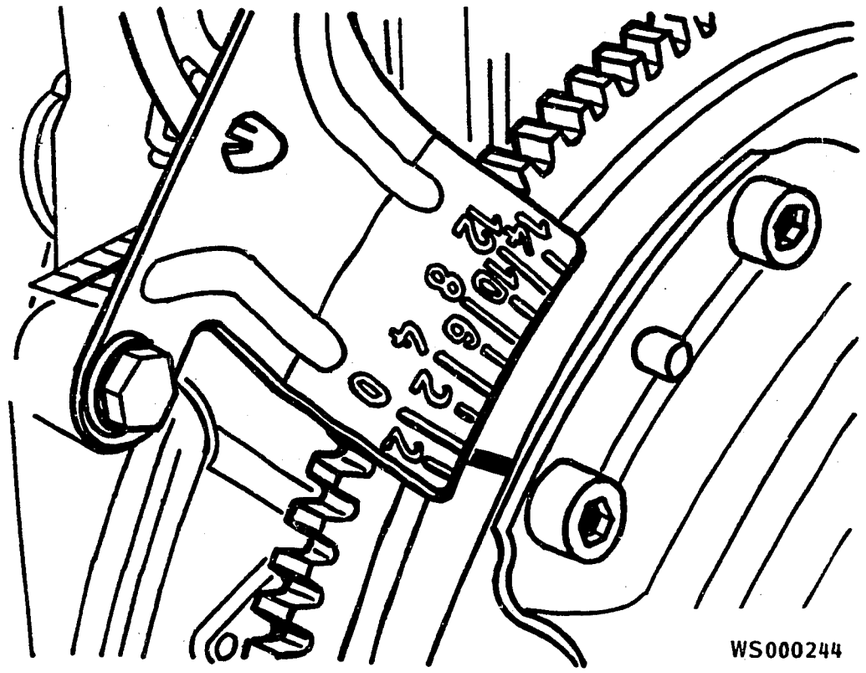
1 = Ignition-distributor housing
2 = Distributor cap
3 = Distributor arm (rotor)
4 = Protective cover
5 = Support
6 = Retaining ring
7 = 4-pole rotor
8 = Pulse-generator coil
9 = 4-pole stator
10 = Base plate
11 = Vacuum unit
12 = Ignition module (trigger box)
13 = Ignition coil
14 = Ignition-coil mount



1 = Trigger-box plug
2 = Adjustment slot in ignition-distributor housing
3 = Ignition coil with holder
4 = Adjustment mark (cylinder no. 1) on ignition-distributor housing

3.2 Removal and installation of ignition distributor

The ignition distributor can easily be removed after taking off the distributor cap, detaching the vacuum line and separating the plug connection to the trigger box.
Before re-installing the ignition distributor, check the condition of the O-ring between cylinder head and ignition distributor.
When inserting the ignition distributor, turn the shaft such that the driver engages properly (there is only one position).
Then tighten the retaining screw temporarily, fit distributor rotor/distributor cap and insert trigger-box plug.

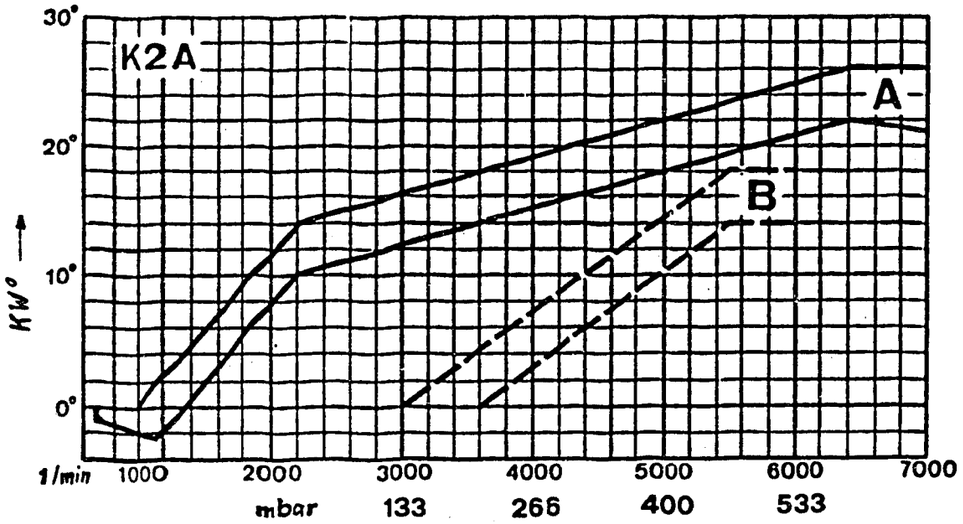


Marking plate for ignition point and TDC on clutch housing and mark on flywheel

3.3 Adjusting ignition point

For precise adjustment, a timing light is to be connected up and the vacuum line removed.
With the engine at operating temperature, the idle is to be set to 750 min-1 and the ignition point then checked with the lamp pointing towards the ignition mark on the clutch housing (top picture).
It should be precisely 8° before TDC.
If necessary, correction is to be effected by turning the ignition distributor.

The fastening screws of the ignition distributor are then to be tightened, the vacuum hose fitted and the idling speed corrected again if necessary.



WS000245

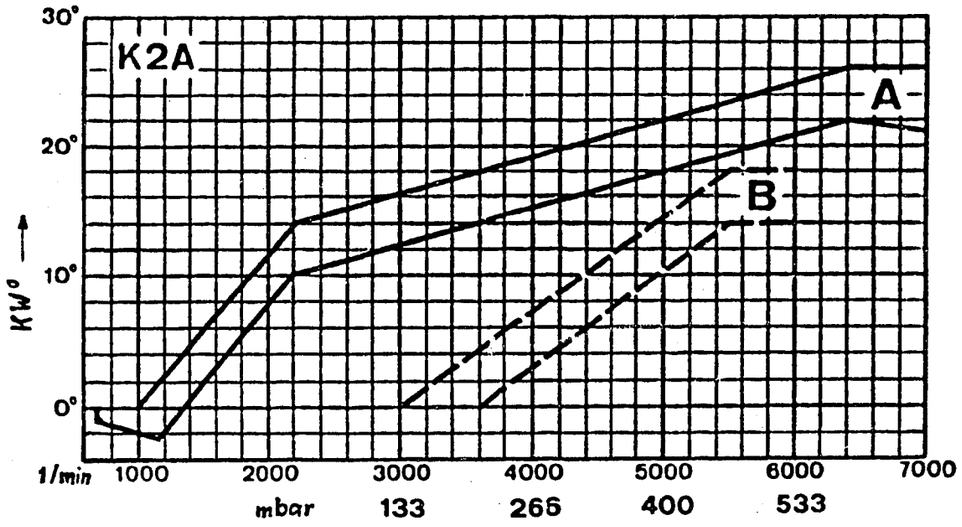
A = Centrifugal advance
B = Vacuum advance

3.4 Checking advance curves

A timing light and a rev counter are to be connected up after detaching the vacuum hose from the vacuum unit.

Provided that the basic setting (8° before TDC) is correct, adjustment to 0° is then to be effected with the phase adjuster, in order to subsequently check the centrifugal advance with slow acceleration of the engine on the basis of curve A (top picture).

The ignition distributor is to be replaced if the values indicated are outside the tolerances.



WS000245

A = Centrifugal advance
B = Vacuum advance

Graph with advance curves

A vacuum pump is to be connected to the vacuum unit to check the vacuum advance.

At an engine speed regulated to 2500 min-1, the advance curve with various vacuum values is then to be compared to the set values, curve B (top picture).

In the event of deviations, the vacuum unit is to be replaced or/and the setting plate checked for freedom of movement.

Technical data

Engine type	K2A TU3S
Cylinder capacity	1361 cm ^{3}
Max. power	62 kW (85 bhp)/ 6400 min-1
Max. torque	114 Nm/4000 min-1
Ignition system	Ducellier
Ignition distributor	Ducellier 52 256 51 A
Ignition coil	Ducellier 520 073
Primary resistance	0.7 Ω (at 20°C)
Secondary resistance	6.0 k Ω
Spark plugs	Eyquem FC 62 LS
Electrode gap	0.80 mm
Basic ignition setting	8° before TDC at 700 min-1 (vacuum hose detached)
Firing order	1 - 3 - 4 - 2 (cylinder no. 1 flywheel side)
Idling speed	750 min-1

Citroen CX 25 I.E. Turbo 2
(engine type M25/666 1GJ09)

The distributorless semiconductor ignition system (EA) is basically the same as that of the Citroen CX 2500.
It does not however make use of a TDC and an engine-speed sensor, but rather of a combined engine-speed/reference-mark sensor. A knock sensor is also provided.

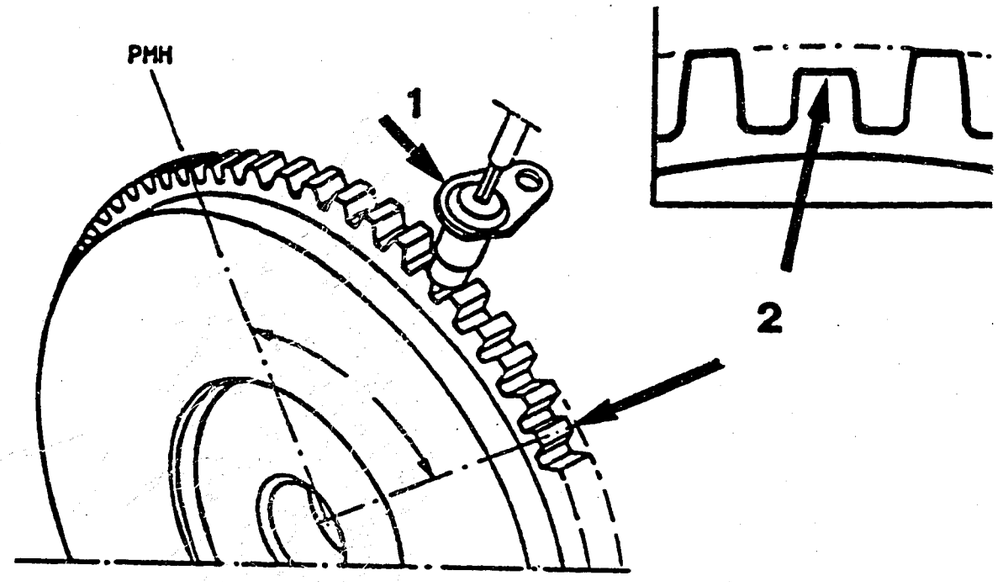
1. Design and mode of operation

The fully electronic ignition consists of an engine-speed/reference-mark sensor, which is attached to the back of the engine block, and the control unit which is located on the wheel house, front left.

The engine-speed/reference-mark sensor supplies the pulses for detecting the piston position (TDC) and the engine speed.

Also provided is an absolute-pressure sensor at the engine bulkhead.

In view of the fact that there is no H.T. ignition distributor, the control unit actuates two ignition coils with two H.T. outputs in each case which route the high voltage directly to the spark plugs.



WS000246

The engine-speed/reference-mark sensor (1) recognizes the piston position (TDC) on the basis of the 0.3 mm lower reference tooth (2) and the engine speed on the basis of the other teeth (total number of teeth = 145).

2. Testers

The manufacturer supplies a special tester (OUT 106 029 T), which can be used both for testing this ignition system and for that of the CX 2500.
The ignition system can however also be tested without problem using a voltmeter and ohmmeter and a test lamp.
A timing light with phase displacement and a pressure gauge are required for checking the timing.

3. Trouble-shooting and elimination of faults

When it has been established that the battery is fully charged and that both the ground cable and its connections are OK, proceed as follows:

3.1 Perform spark check at each cylinder with spark tester. If spark is OK, consecutively check the following:

- the spark plugs (only the prescribed spark plugs may be used)

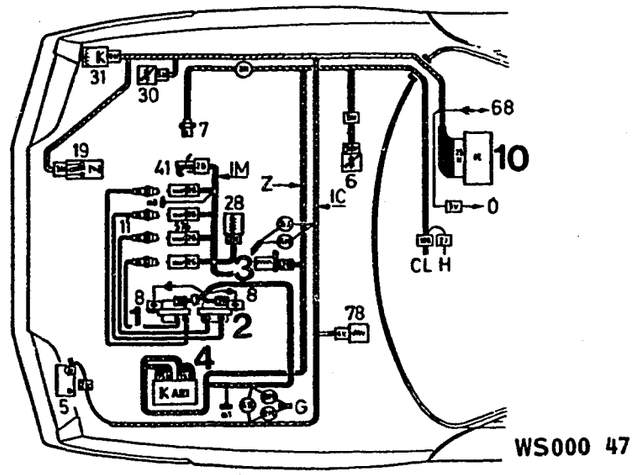
- the connecting cable between control unit (AEI) and the injection control unit for continuity and contact corrosion (see picture)

- the fuel-injection system.

3.2 If there is no ignition, connect an indicator lamp to + and - terminal of ignition coil and actuate starter.

- If the indicator lamp does not flash regularly, the primary circuit is to be checked in accordance with the following paragraphs a, b and c.

- If the indicator lamp flashes regularly, the secondary circuit is to be checked in accordance with item d.



4 = Control unit AEI (FI)
10 = Fuel-injection control unit

3.3 Check voltage supply and resistances at ignition coils, engine-speed/reference-mark sensor, knock sensor and control unit.

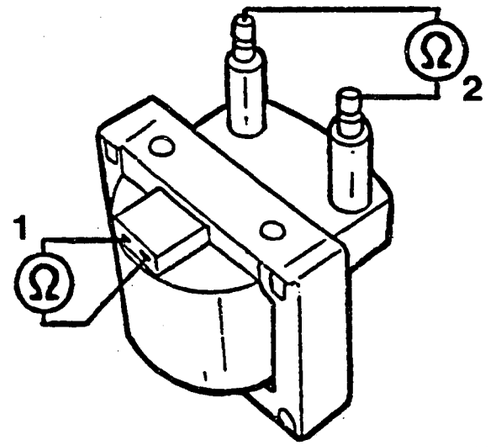
a) The primary resistance (top picture, 1) of the ignition coils between terminals 1 and 3 (or 9 at pulled-out plug of AEI control unit) must be approx. 1.5 – 2 Ω .

b) The secondary resistance measured between the two H.T. connections (picture, 2) should be 3.5 – 4.0 k Ω . The insulation resistance between primary circuit and secondary circuit should be infinity Ω .

c) The internal resistance of the engine-speed/reference-mark sensor between terminals N6 and N13 of AEI control unit (plug pulled out) must be 50 Ω . The coil must be insulated with respect to the core (resistance infinity Ω).

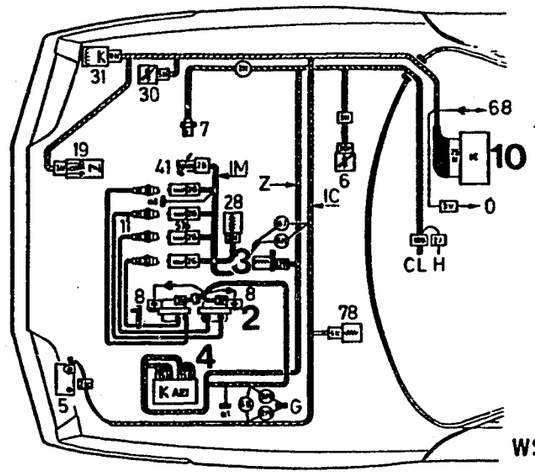
d) Voltage supply and ground of AEI control unit:

- The voltage between terminal N10 and N2 should correspond to battery voltage.
- Battery voltage should be applied between terminals N2 and N11 with starting motor in operation.
- The resistance between terminals N2 and N14 and ground must be 0 Ω .
- The terminal B9 supplies the rev counter.



WS000287

1 = Ignition coil of cylinder 1 + 4
2 = Ignition coil of cylinder 2 + 3
3 = Engine-speed/reference-mark sensor
4 = Control unit AEI (FI)
10 = Fuel-injection control unit



WS000 47

3.4 Knock sensor

- If the knock control system or knock sensor fails, the knock warning lamp on the instrument panel lights up.

- Should the knock control system fail, the AEI control unit switches automatically to limp-home control, which restricts the advance to 5 ... 8° without interrupting the ignition pulses.

Tightening torque of knock sensor = 23 Nm.

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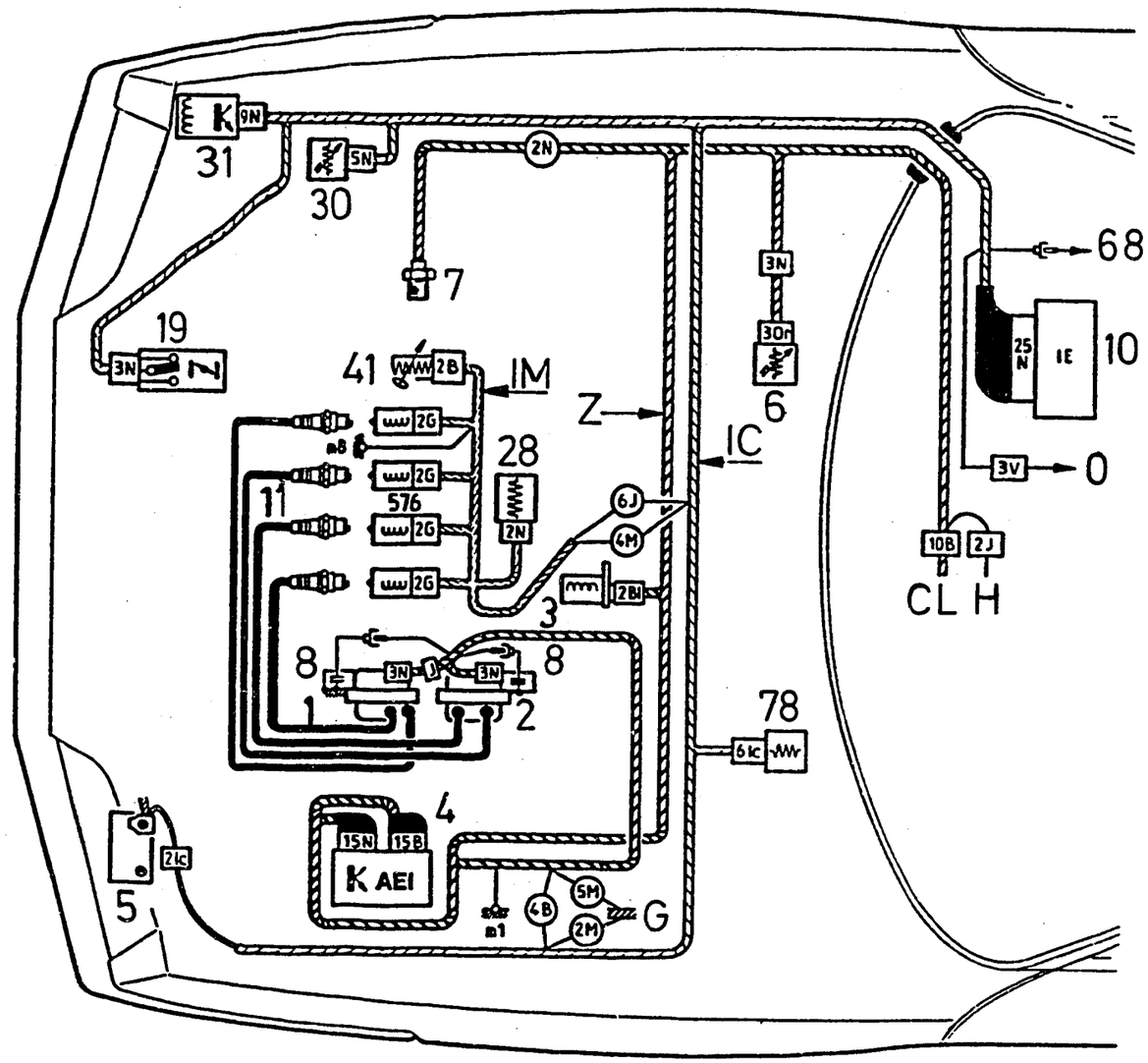


WS000247

1 = Ignition coil of cylinder 1 + 4
2 = Ignition coil of cylinder 2 + 3
3 = Engine-speed/reference-mark sensor
4 = AEI control unit
5 = Battery
6 = Absolute-pressure sensor
7 = Knock sensor
8 = Suppression capacitors

10 = Fuel-injection control unit
11 = Spark plugs
19 = Throttle-valve switch
28 = Auxiliary-air device
30 = Air-flow sensor
31 = Fuel-injection control relay

41 = Coolant-temperature sensor
68 = Fuel pump
78 = Injection-valve resistors
IC = Cable branch of fuel-injection system at bodywork
IM = Cable branch of fuel-injection system at engine
O = to vehicle computer
Z = Cable branch of ignition system

3.5 Testing advance curves

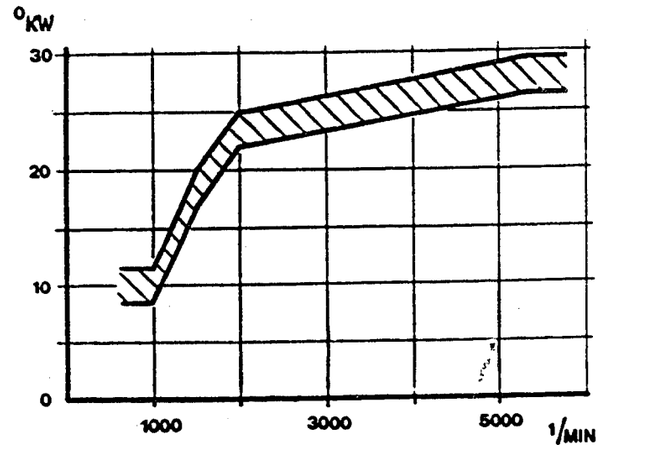
The advance is to be checked using a timing light:

- The vacuum hose at the pressure sensor is to be detached for testing the speed-dependent advance.

- The basic ignition setting is 10° before TDC. The max. advance without charge-air pressure and knock correction at 2000 min-1 is 23.5° (see top picture).

- For checking the pressure-dependent advance curve, a precision pressure gauge is to be inserted in the absolute-pressure-sensor line (advance curve, see bottom picture).

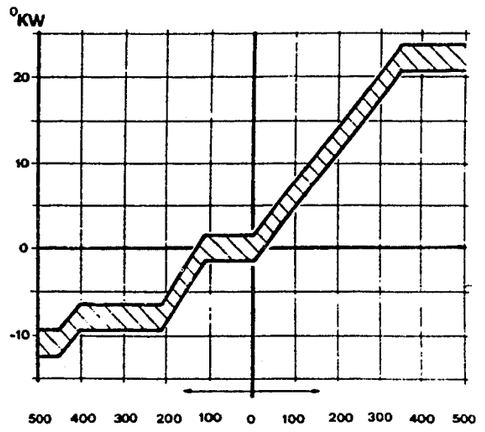
Note: the supply cable of the ignition coil for cylinders 1/4 is marked by way of red adhesive tape.



WS000248

Advance curve as a function of engine speed.
Basic setting = 10° TDC

Pressure-dependent advance curve: left, pressure in mbar; right, vacuum in mbar



WS000249

Technical data

Engine type	M25/666 1GJ09
Cylinder capacity	2500 cm ^{3}
Max. power	122kW (168 bhp)/ 5000 min–1
Max. torque	290 Nm/3250 min–1
Ignition system	EA
Control unit	EA EC 002 ED 003
Engine–speed/reference–mark sensor	EA part no. 95 496 547
Absolute–pressure sensor	GM 16 038 177
Ignition coil	Delco Remy
Primary resistance	1...2 Ω
Secondary resistance	3.5...4.0 k Ω
Spark plugs	Champion L 82 Eyquem 755 X
Electrode gap	0.8...0.9 mm
Basic ignition setting	10° before TDC
Firing order	1 – 3 – 4 – 2
Engine–speed/reference–mark sensor	
Air gap	1.0 ± 0.5 mm
Resistance	50 Ω
Idling speed	750...850 min–1
with A/C	Accelerated idle 900...1000 min–1

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl–Ing. HTL
Ingenieurbüro für Auto–Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto–Technik" magazine published by the AT–Fachschriftenverlag AG, CH–5001 Aarau.

IGNITION (FEI, Magneti Marelli)

Fiat Regata 1600i.e. Cat

The fully electronic ignition system is the Digiplex 2 system from Magneti Marelli.
This system consists of an electronic control unit, which is mounted on the engine bulkhead, an integrated pressure sensor, an H.T. distributor, one engine-speed and TDC sensor each, the ignition coil and the spark plugs.

Ignition timing is effected on the basis of the digitally processed engine-speed and vacuum information as well as the maps stored in the control unit.

There are a total of 8 programmed advance curves with 64 engine-speed ranges each (see graphs) for 8 different intake-manifold vacuum statuses.

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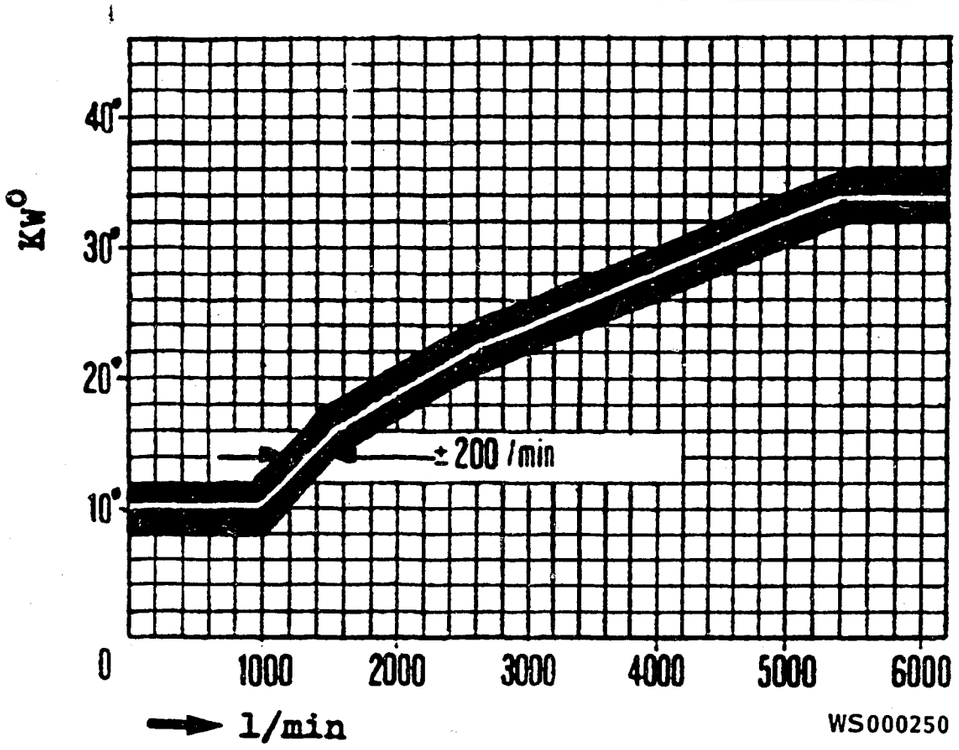
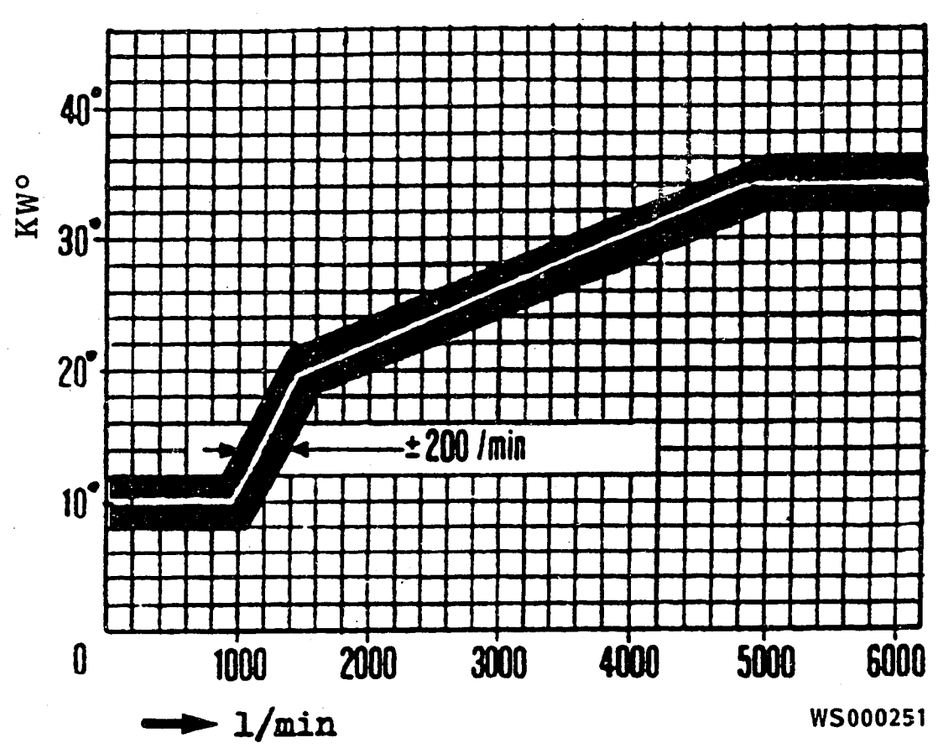
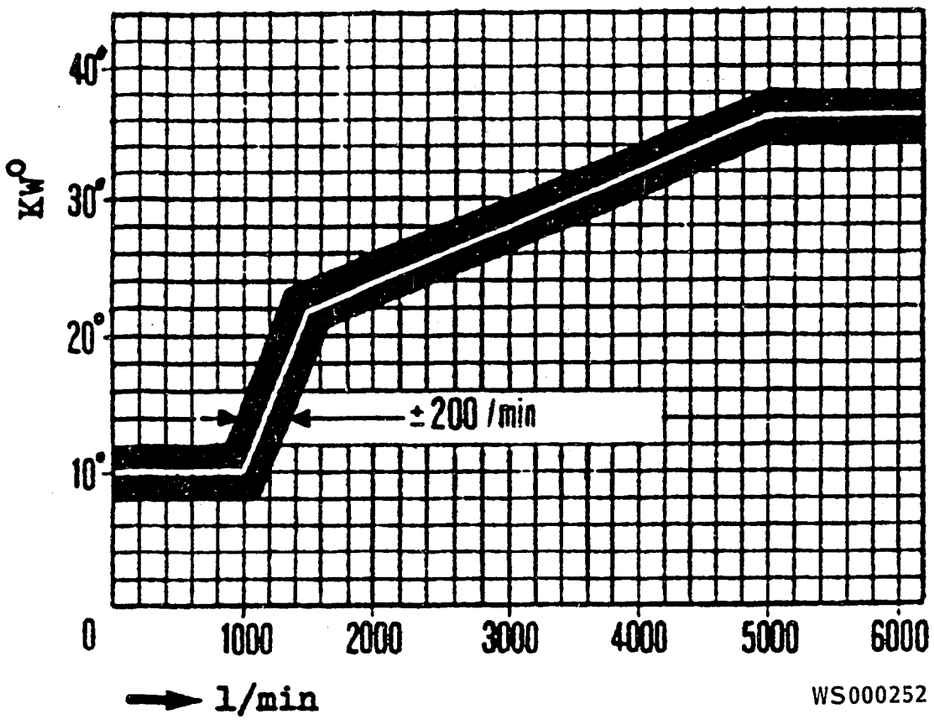


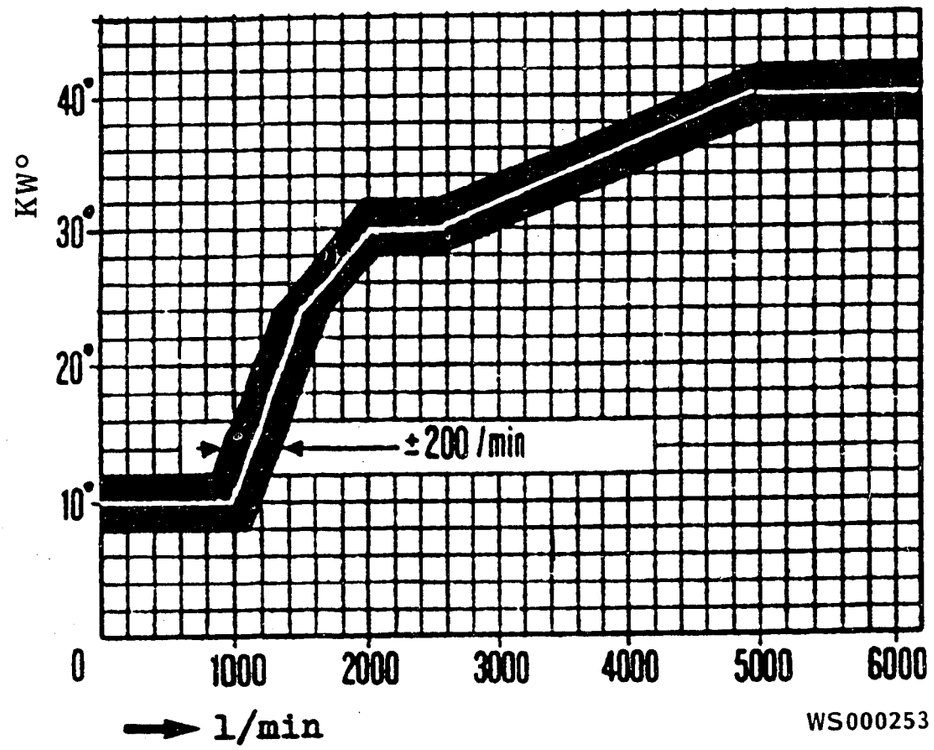
Advance curve at 0,040 mbar



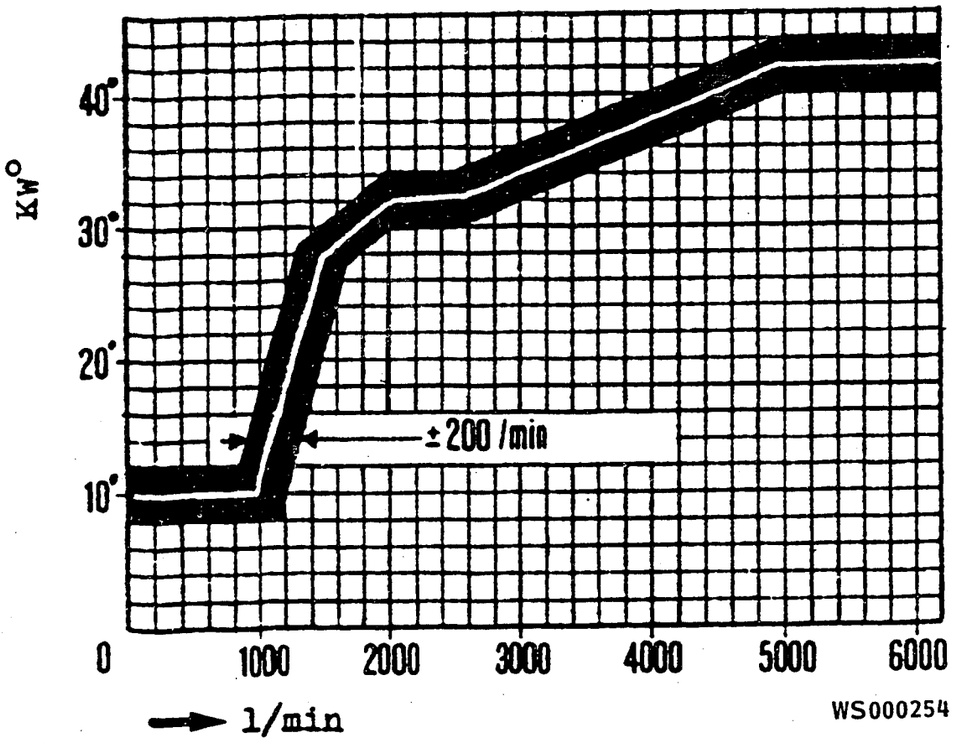
Advance curve at 0,120 mbar



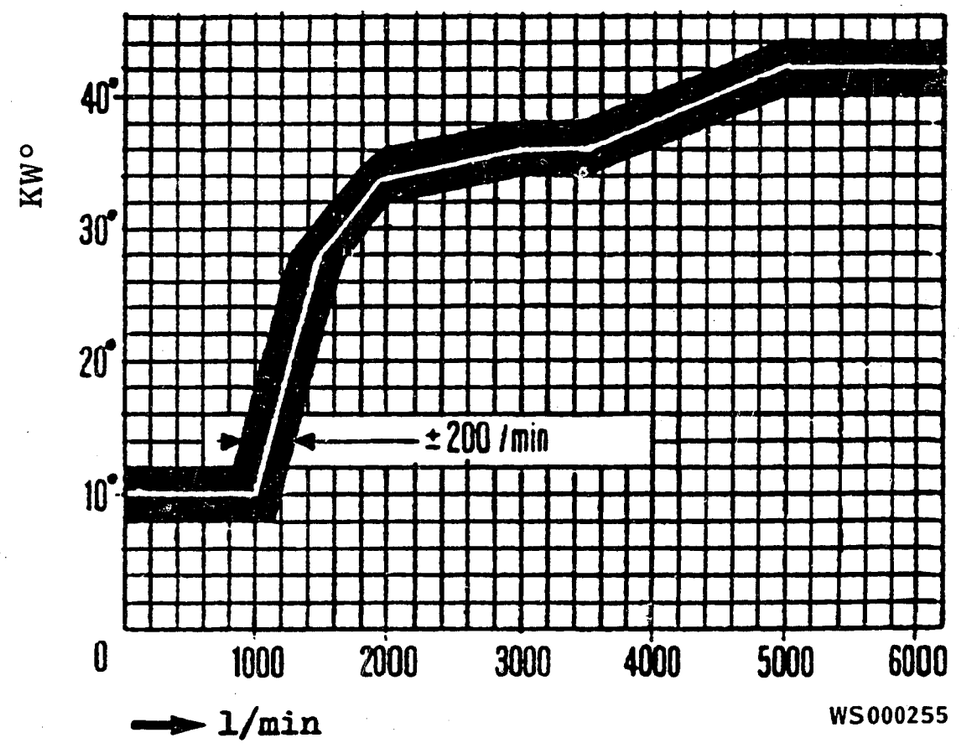
Advance curve at 0,200 mbar



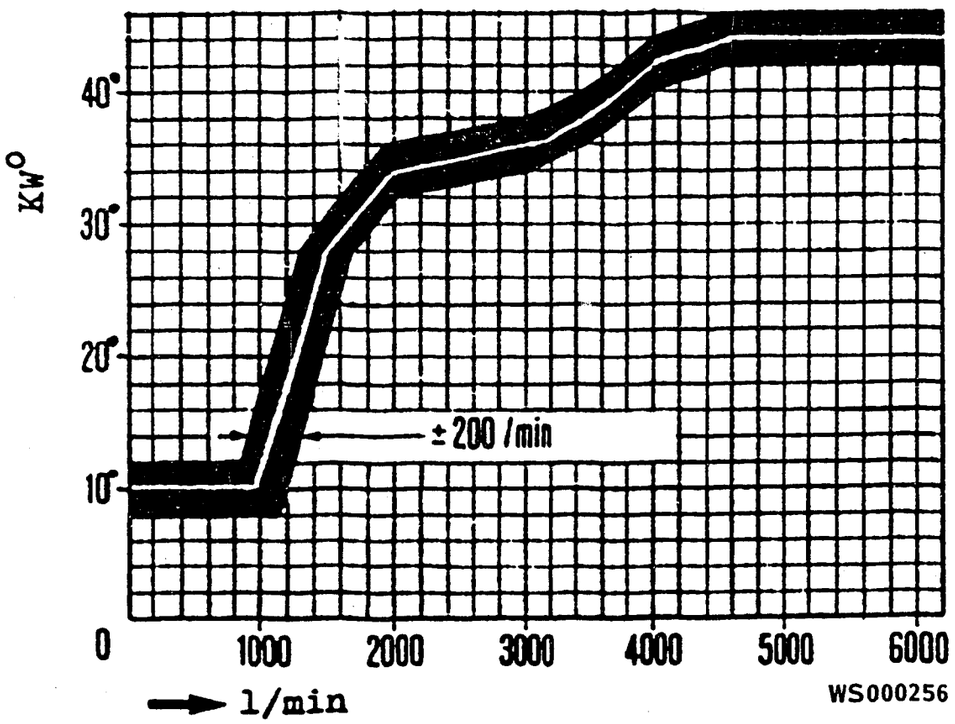
Advance curve at 0,280 mbar



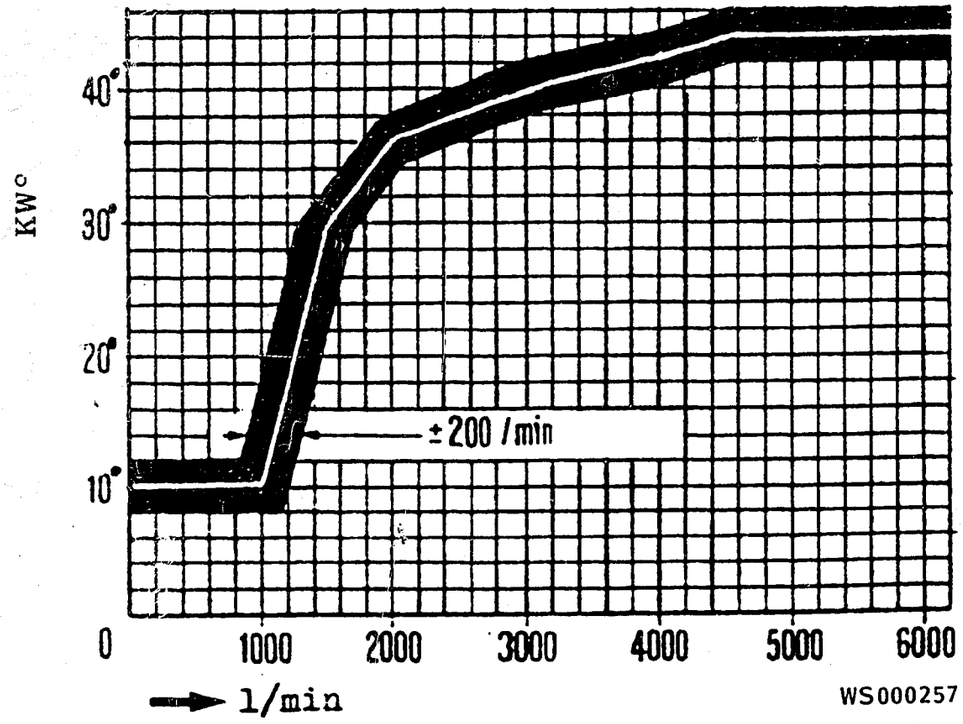
Advance curve at 0,360 mbar



Advance curve at 0,440 mbar



Advance curve at 0,520 mbar



Advance curve at 0,600 mbar

1. Safety precautions

- Never disconnect battery with engine running.

- Never start engine with fast charger.

- Detach battery from vehicle electrical system when performing fast charging.

- Never pull out or insert plug of control unit with ignition switched on.

- Remove control unit at temperatures in excess of 80° C (stove enamelling).

- Disconnect negative terminal of battery before carrying out electric welding work on vehicle.

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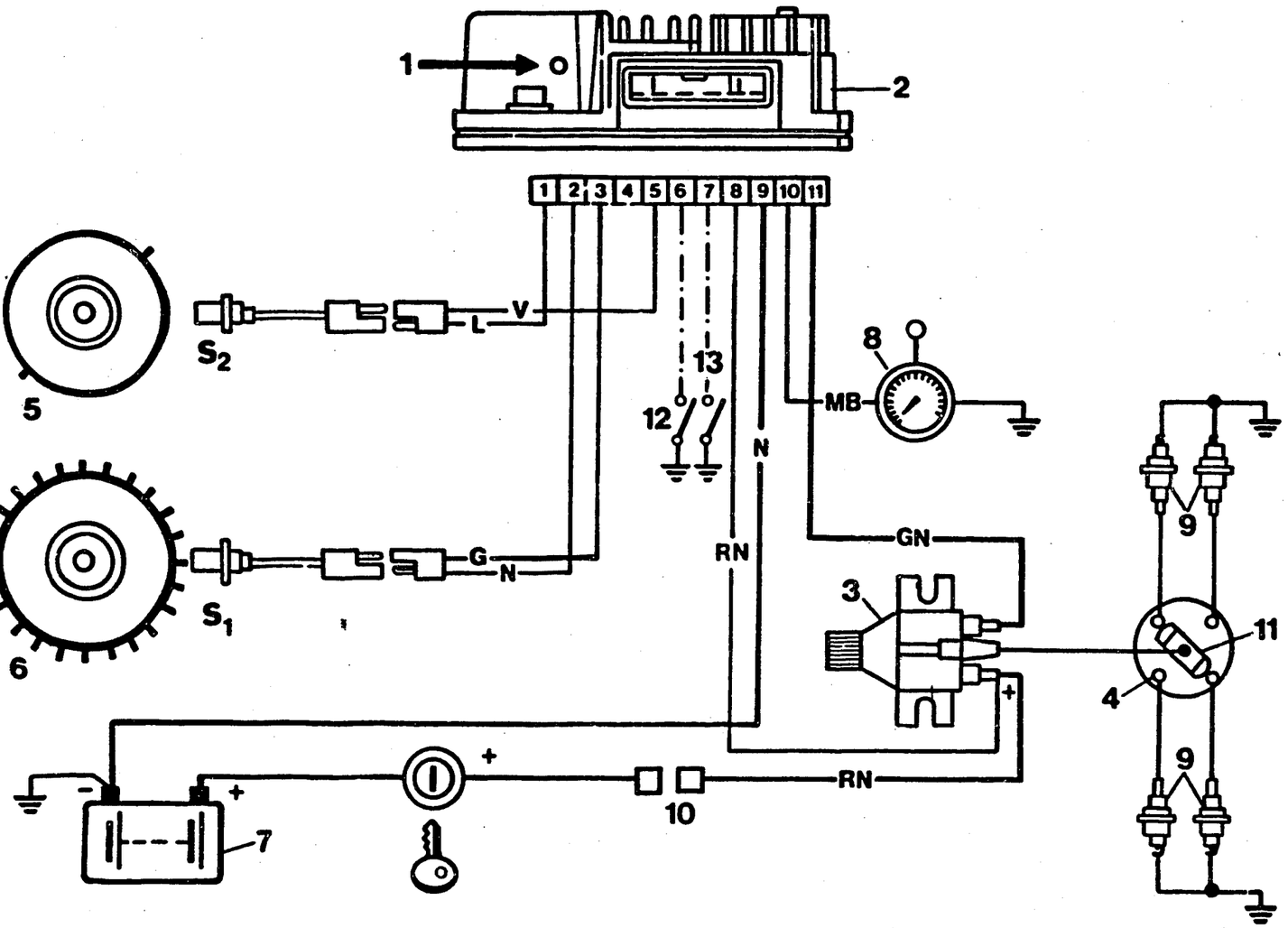
2. Testers

In addition to the tester developed by Fiat, the Digiplex ignition can be tested with a voltmeter and ohmmeter, a rev counter and timing light, and a vacuum gauge.



WS000075

CIRCUIT DIAGRAM OF DIGIPLEX IGNITION SYSTEM:

S1 = Engine-speed sensor
S2 = TDC sensor
1 = Vacuum-sensor connection
2 = Electronic control unit
3 = Ignition coil
4 = H.T. distributor
5 = Crankshaft pulley
6 = Flywheel toothed disc
7 = Battery
8 = Engine-speed signal for automatic excess-fuel starting device or consumption indicator
9 = Spark plugs
10 = to automatic excess-fuel starting device
11 = H.T. distributor
12 = Connecting cable for version ES
13 = Connecting cable for version ES

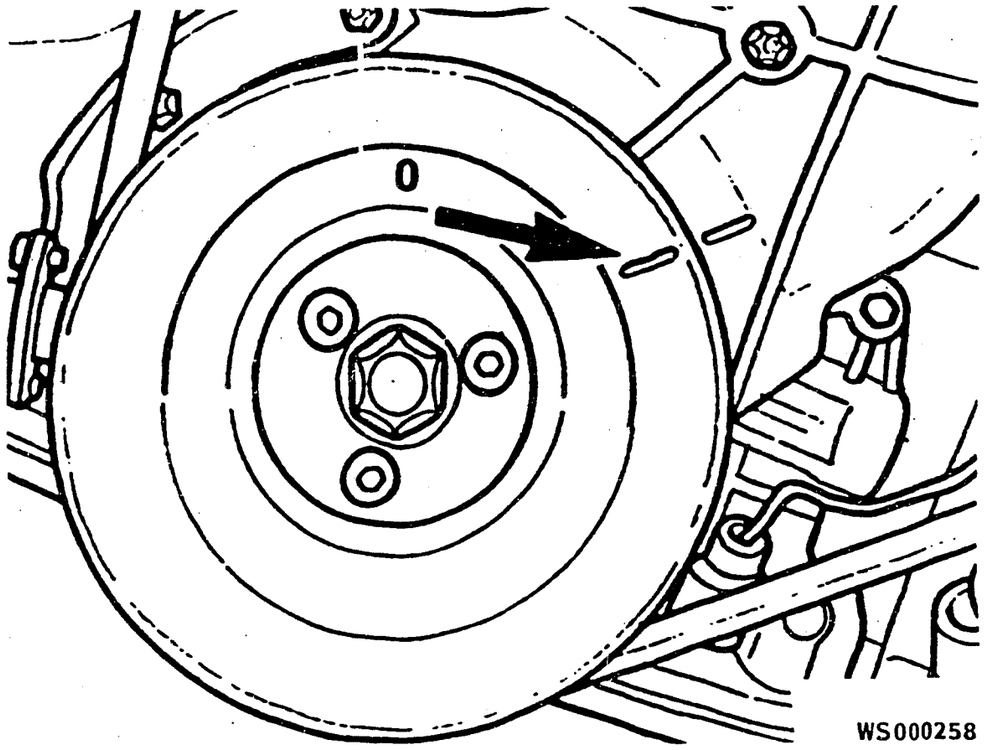
3. Trouble-shooting table

Starting motor operates, warm engine fails to start

Irregular engine running, cylinder failure

Engine stutters, low power, high consumption

			Cause	Remedy
	X		Spark plug, H.T. cable open-circuit	Replace spark plugs
X	X		Excessive TDC-sensor air gap	Adjust air gap and possibly sensor holder
X			TDC and engine-speed sensor short to ground or short-circuit or open-circuit	Check resistance, check connections
X			Contact pins of multiple plug oxidized or bent	Clean or straighten contacts
X			Control unit defective	Replace control unit
X			Open-circuit or short-circuit in ignition coil	Eliminate fault, renew if necessary
X			Ignition distributor defective or open-circuit at contact 8 of control unit	Repair ignition distributor or eliminate fault in connections and terminal
		X	Fuel-system problems (pump, injection, tank ventilation)	Repair fuel system
X	X	X	Not enough compression (valves, timing, piston rings)	Mechanically repair engine
		X	Incorrect ignition timing, interruption in vacuum line to control unit	Flywheel teeth broken, control unit defective, renew vacuum line
	X	X	Intake manifold leaking	Check, grind surface, re-seal



Ignition-point marks on crankshaft V-belt sprocket and toothed-belt cover

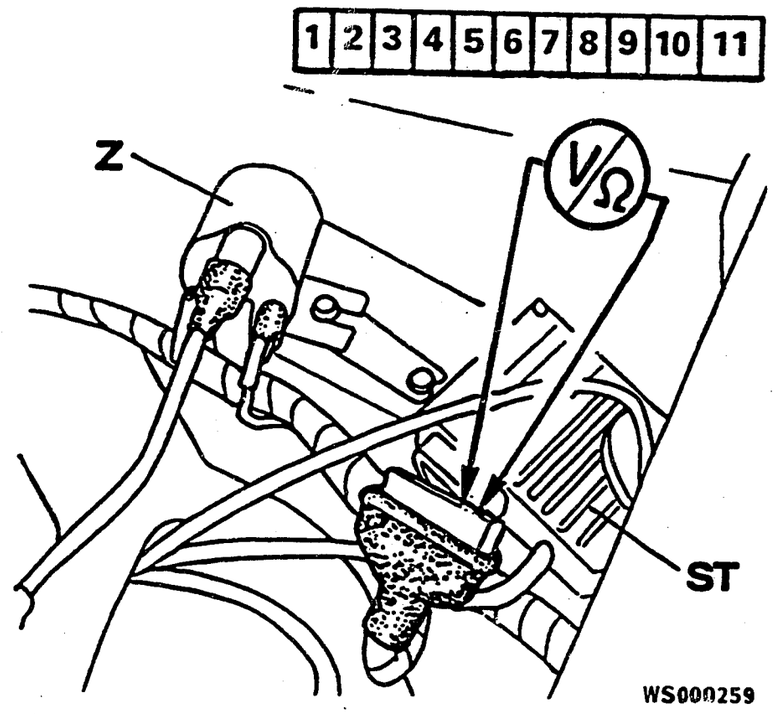
4. Testing of individual components

a) Ignition point and advance are to be determined with timing light, vacuum gauge and rev counter, and compared to the set values on the graphs.

The marks are located on the crankshaft pulley and on the toothed-belt cover (see top picture).

At an engine speed of 700 ... 1200 min-1 the ignition point must be 8 ... 12° before TDC.

In the event of deviations, a check is to be made on the TDC sensor, the engine-speed sensor, the flywheel teeth and the vacuum line.



Measurements at detached control-unit plug

Z = Ignition coil
ST = Control unit

b) Measure resistance of TDC and engine-speed sensor at pulled-out plug of control unit (see top picture).

TDC sensor between terminals 1 and 5,
Engine-speed sensor between terminals 2 and 3.

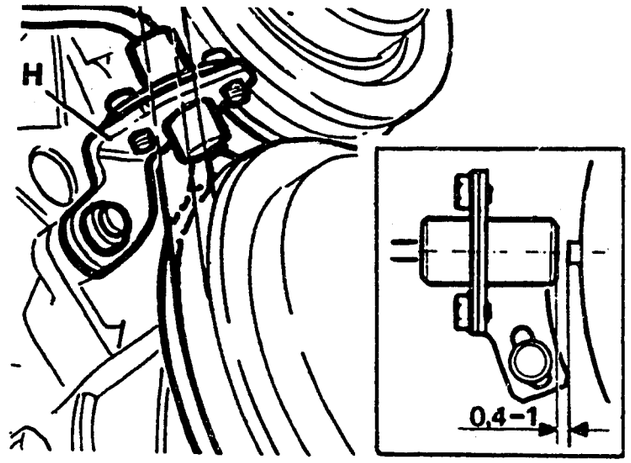
Resistance = 618...748 ohms.

If not correct, check plug connections.
Renew sensor if necessary.

c) Check air gap between TDC and engine-speed sensor and hub of pulley (top picture)/flywheel toothing (center picture), and compare to set values.

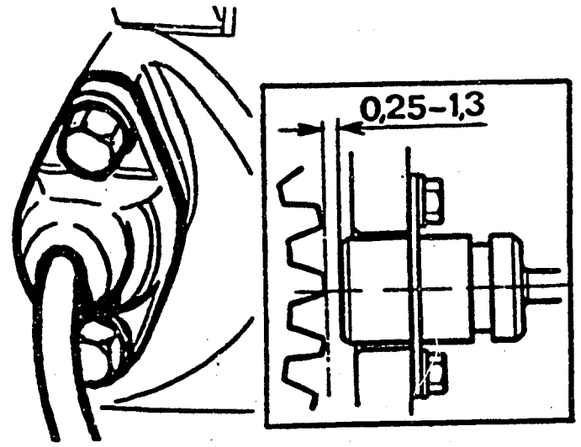
Excessive spacing can cause malfunction.

Top picture:
TDC sensor at crankshaft V-belt sprocket.
Right: air gap between sensor and hub
H = Sensor holder.



WS000260

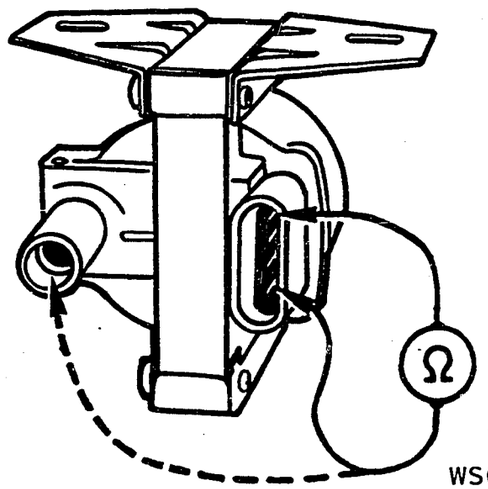
Center picture:
Engine-speed sensor at flywheel housing.
Right: air gap between toothing and sensor.



WS000261

d) Ignition coils, primary and secondary resistance.
These are to be measured with an ohmmeter in accordance with bottom picture.

Set values at 20°C:	Primary resistance	0.310...0.378 ohms
	Secondary resistance	3.33...4.07 kohms
Interference-suppression resistance in ignition-distributor cap		800...1200 ohms



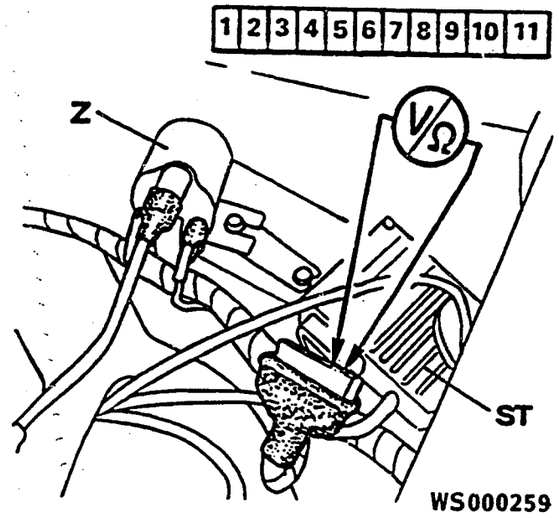
WS000262

e) Voltage supply of ignition coil.

With multiple plug detached, use voltmeter to measure voltage between contacts 9 and 11.

Battery voltage must be applied when ignition is switched on.

If not, the connections at the control unit and ignition coil are to be checked.



f) Voltage supply of control unit which is supplied with voltage via contact 8. Battery voltage must be measured if a voltmeter is connected between contacts 8 and 9.

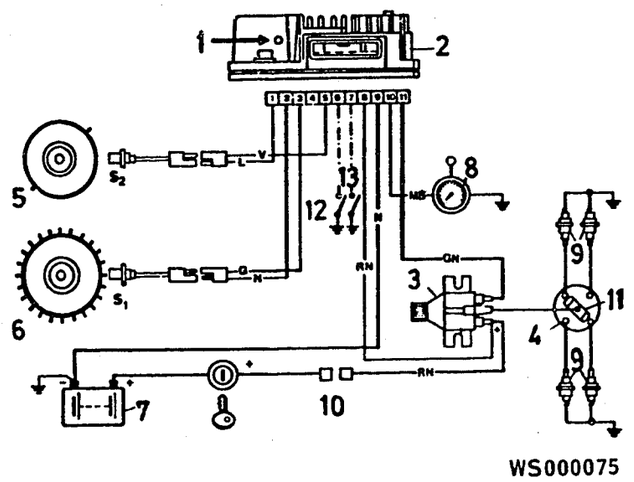
If this is not the case, there is an open-circuit in lead or ground connection.

g) Vacuum-sensor check.

With the engine running, the signal voltage of the vacuum sensor can be measured with the aid of a precision voltmeter, which is to be connected to terminal 10 of the connected control-unit plug or to the rev counter, and a vacuum gauge.

Set values:

Pressure in mbar at vacuum connection	Voltage in V
80	1.0
160	1.3
240	1.7
320	2.0
400	2.3
480	2.7
560	3.0
666	3.5
With engine stopped	0.6...0.8



Technical data

Engine	Type	1600i.e. 2 ACT Cat
	Power (kW)	66 (90 bhp)/6250 min-1
	Torque (Nm)	123 at 4250 min-1.
Ignition system	Make	Magneti Marelli
	Type	Digiplex 2
	Firing order	1 - 3 - 4 - 2
Spark plugs	Make/Type	Bosch Wr 7 DC Marelli F 7 LCR
	Electrode gap	0.7 ... 0.8 mm
Ignition coil	Make	Magneti Marelli
	Type	BAE 209 BK
	Primary resistance	0.310...0.378 ohms
	Secondary resistance	3.33...4.07 kohms
Ignition distributor	Make	Magneti Marelli
	Type	DT 456 AX
	Ignition point	8...12° at 700...1200 min-1
Control unit	Make	Magneti Marelli
	Type	AEI 500 F
Engine-speed and TDC sensor	Resistance	618...748 ohms
	Air gap	0.25...1.3 mm 0.40...1.0 mm

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

The BOSCH equipment and the test specifications/ settings for BOSCH products and components are always to be taken from the BOSCH microcards. Test specifications and circuit diagrams are contained in the microcards and workshop documentation already introduced into BOSCH after-sales-service workshops.

LANCIA THEMA 2000ie 16V, 1989 ->

The fully electronic ignition system in the 16 V features stationary high-voltage distribution.

The electronic control unit, which is located at the front left of the engine compartment (directly in front of the battery), determines the respective ignition point on the basis of the input signals of the joint TDC and engine-speed sensor, the intake-manifold vacuum and the ignition map stored in the control unit.

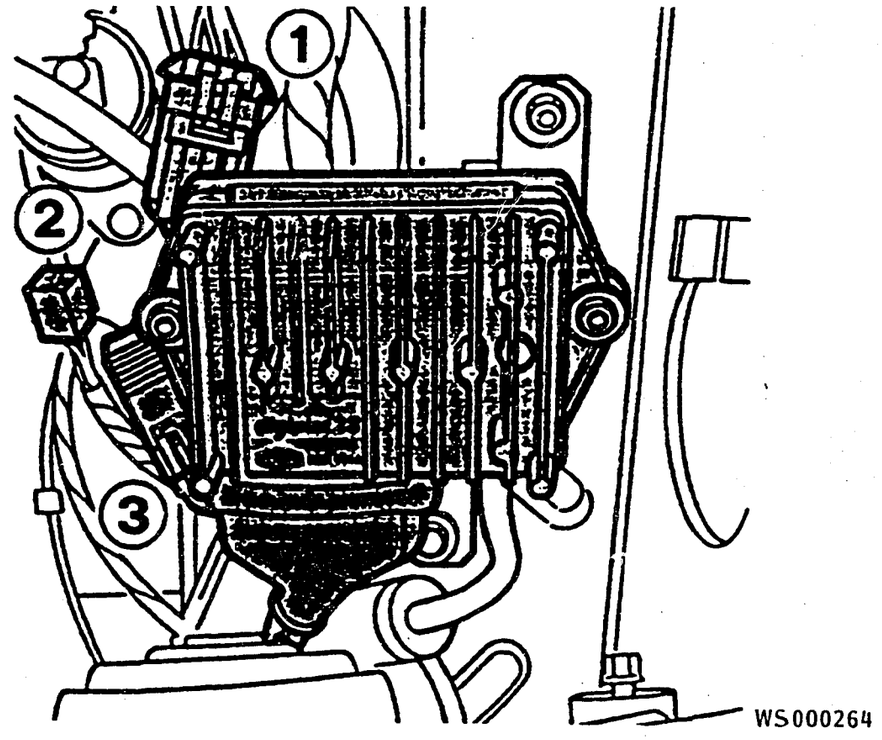
The high voltage is conditioned in two twin-spark ignition coils and routed from their high-voltage outputs directly to the spark plugs.

In this process, sparkover takes place simultaneously (in the compression and exhaust stroke) in each case at the two spark plugs connected to the same ignition coil.

One ignition coil supplies cylinders 1 and 4, whereas the other coil supplies cylinders 2 and 3.

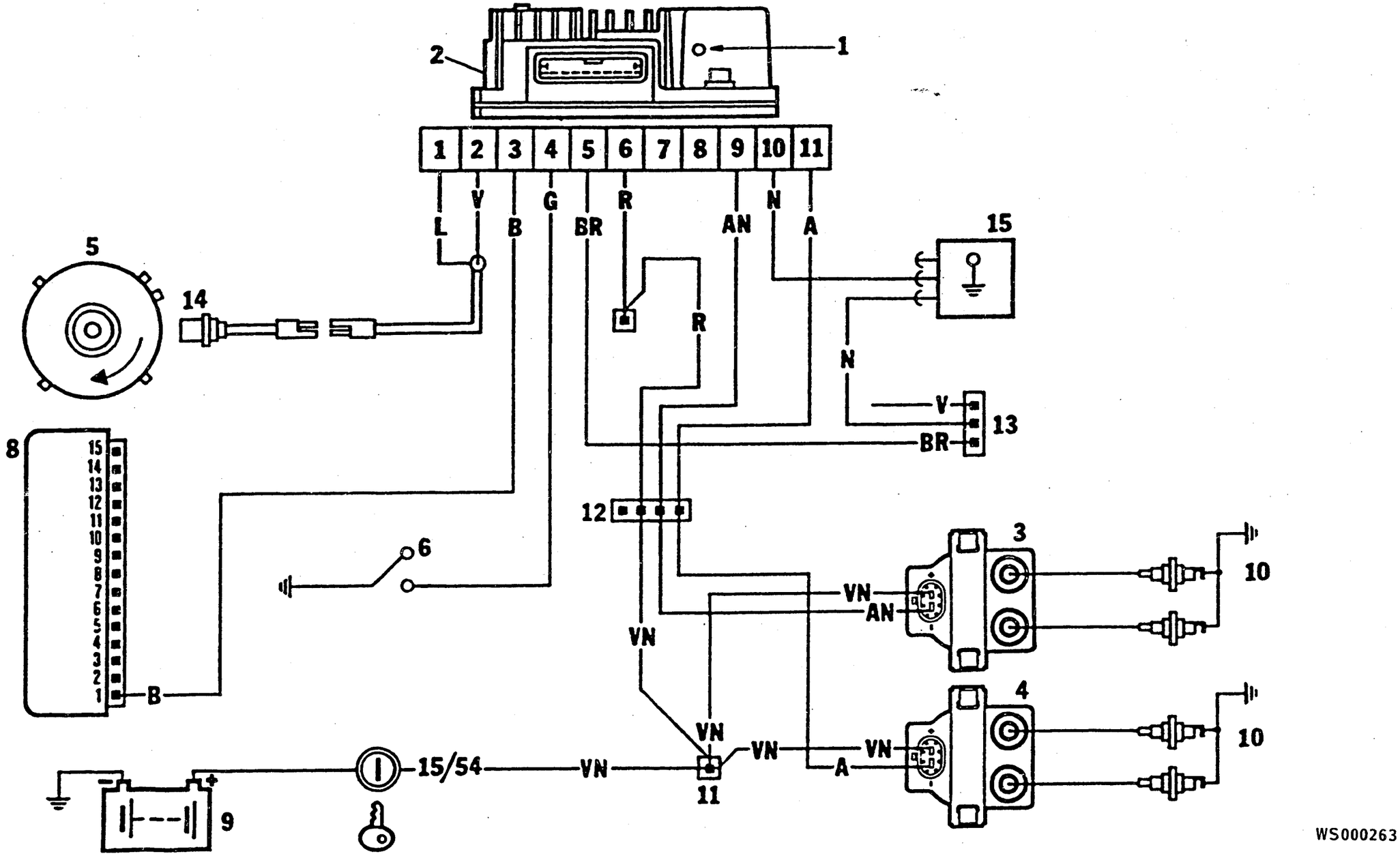
The high voltage at the two series-connected spark plugs is however not the same.

On account of the compression pressure, a considerably higher voltage is required to overcome the air gap (electrode gap) at the spark plug of the cylinder in the compression stroke than that needed at the spark plug which is simultaneously ignited in the exhaust stroke.



Position of ignition control module in engine compartment:

1 = Plug (12 in schematic)
2 = Diagnosis plug
3 = Cable connector (13 in schematic)



SCHEMATIC VIEW OF ELECTRONIC DIGIPLEX 2 IGNITION

1 = Vacuum connection
2 = Control module
3 = Twin-spark ignition coils
4 = Twin-spark ignition coils
5 = Crankshaft pulley
6 = On/off switch for ignition retard
8 = Control unit of fuel-injection system
9 = Battery
10 = Spark plugs
11 = Cable connector
12 = Cable connector
13 = Diagnosis plug
14 = Engine-speed and TDC sensor
15 = Ground connection, front left

1. Safety precautions

- Never start engine with battery connections detached.

- Never start with fast charger.

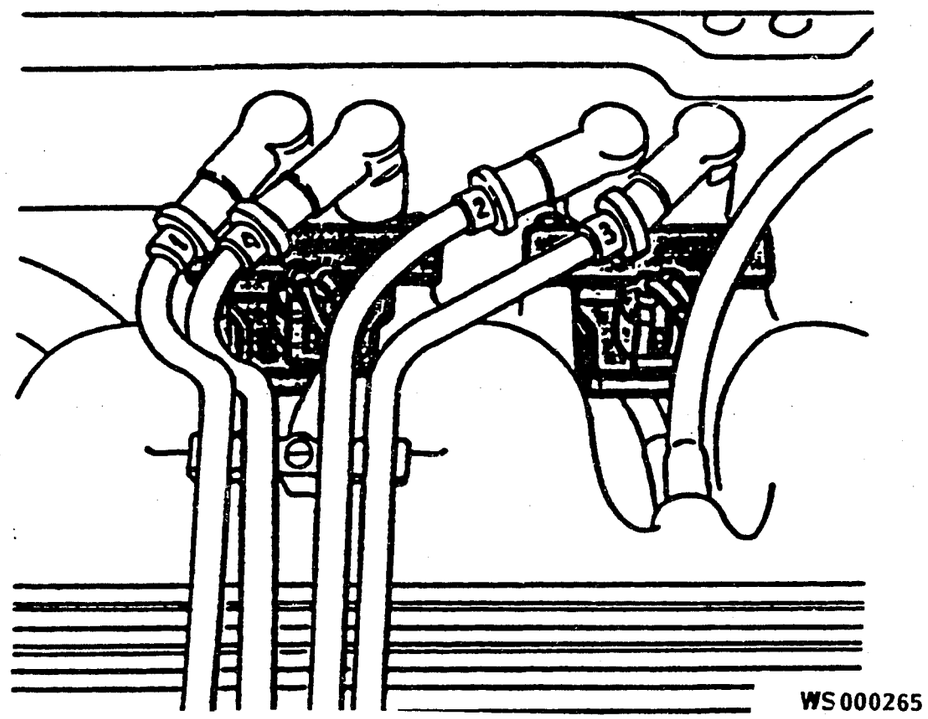
- Never disconnect battery with engine running.

- Disconnect battery from vehicle electrical system for fast charging.

- Remove control unit at temperatures in excess of 80° C (stove enamelling).

- Disconnect battery before performing electric welding work.

- Neither detach nor connect plug of control unit with engine switched on.



2. TESTERS

A special Fiat-Lancia tester is available for performing tests and for trouble-shooting.

Checking and trouble-shooting can however also be performed with standard equipment namely voltmeter, ohmmeter, vacuum gauge, rev counter and timing light.

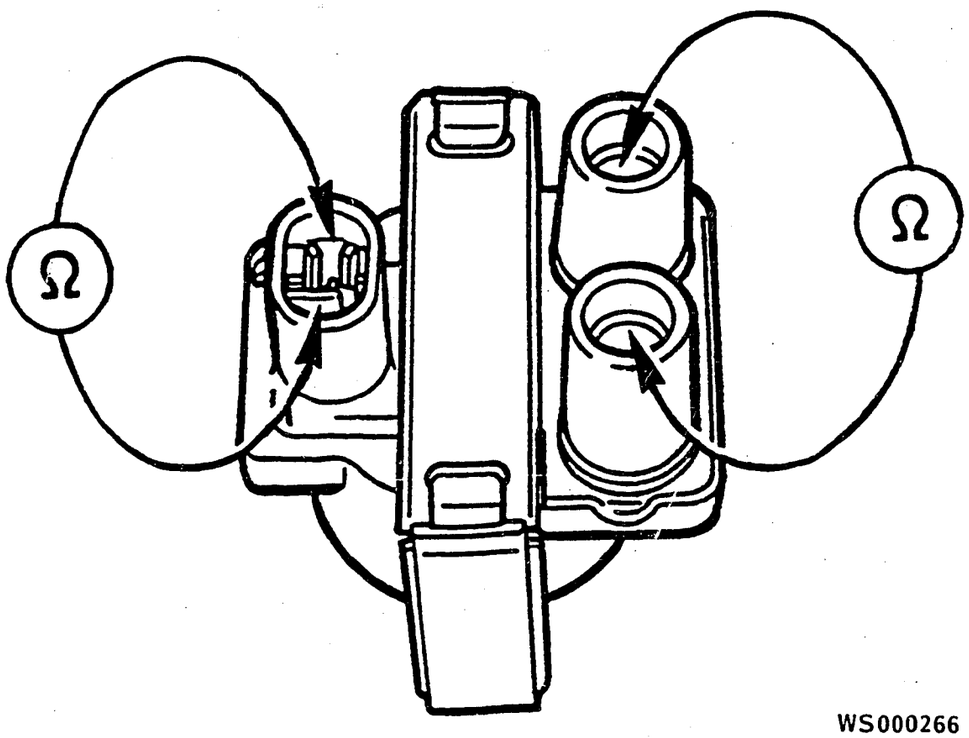
3. TROUBLE-SHOOTING TABLE

Starting motor operates, warm engine will not start

Irregular engine running, cylinders missing

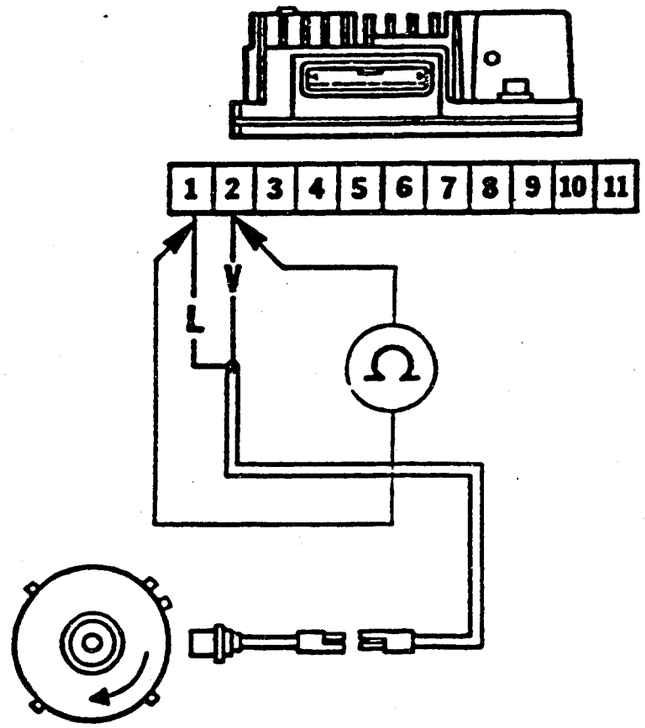
Engine stutters, low power, high consumption

Starting motor operates, warm engine will not start	Irregular engine running, cylinders missing	Engine stutters, low power, high consumption	Cause	Remedy
	X		Spark plug	Replace spark plug
X			Contacts of multiple plug at control unit oxidized or bent	Clean contacts or straighten them
X			TDC and engine-speed sensor defect, short to ground or air gap too large	Check resistance, check connections and air gap
X			Control unit defective	Replace control unit
X			Open-circuit or short-circuit in ignition coil	Replace ignition coil
X			Open-circuit in ignition cable between spark plug and ignition coil or incorrect connection	Replace ignition cable and connect correctly: Ignition coil 1 = cyl.1+4; ignition coil 2 = cyl.2+3
		X	Incorrect advance, control unit defective	Check pulse-generator disk, replace control unit
		X	Leak in vacuum hose	Replace vacuum hose
X		X	Inadequate compression	Check compression, repair engine
	X		Valve burnt	Repair cylinder head
X			Tank ventilation clogged	Repair ventilation line
X		X	Fuel pump defective	Replace pump
X			Water in fuel	Clean tank and lines
		X	Fuel-injection system defective	Check fuel-injection system
	X	X	Leak in intake manifold	Check, grind sealing surfaces, renew seal



WS000266

Left, primary resistance
Right, secondary resistance



WS000267

b) Testing of combined TDC and engine-speed sensor

4. TESTING OF INDIVIDUAL COMPONENTS

a) The ignition coils are to be checked by measuring the primary and secondary resistance (see picture).

If the primary resistance is less than 0.495 ohms or infinity ohms, the ignition coil is to be replaced.

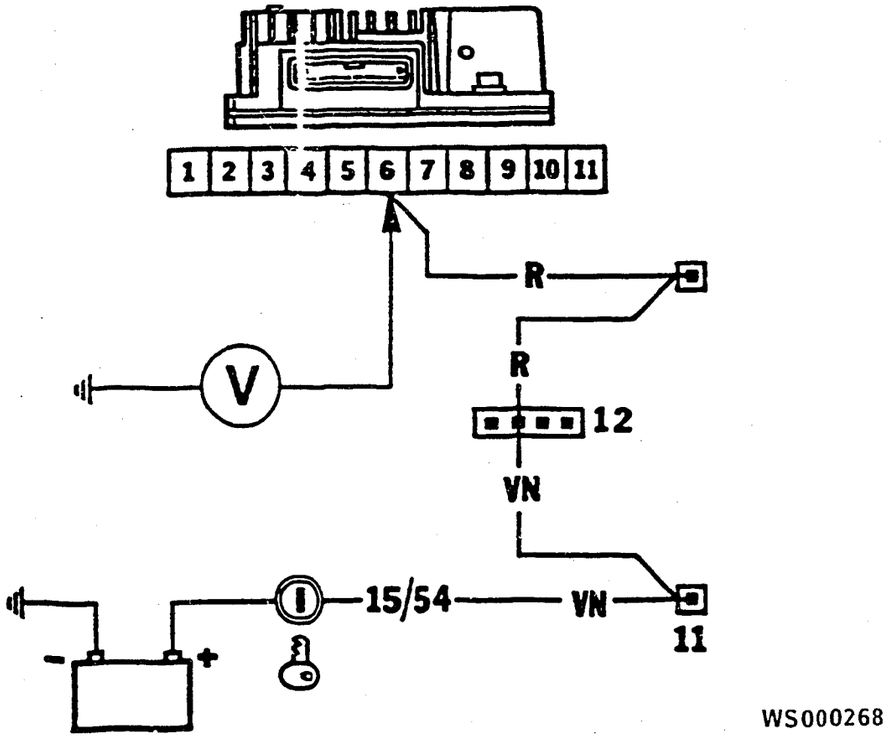
The secondary resistance is measured between the two high-voltage connections and should be between 6.66 and 8.14 kohms.

The ignition coil is to be replaced in the event of lower values or infinity ohms.

After detaching the control-unit plug (to do so press down catch), the resistance of the sensor is measured by carefully inserting the prods of an ohmmeter between the laminations of plug terminals 1 and 2.

The resistance should be 672...782 ohms.

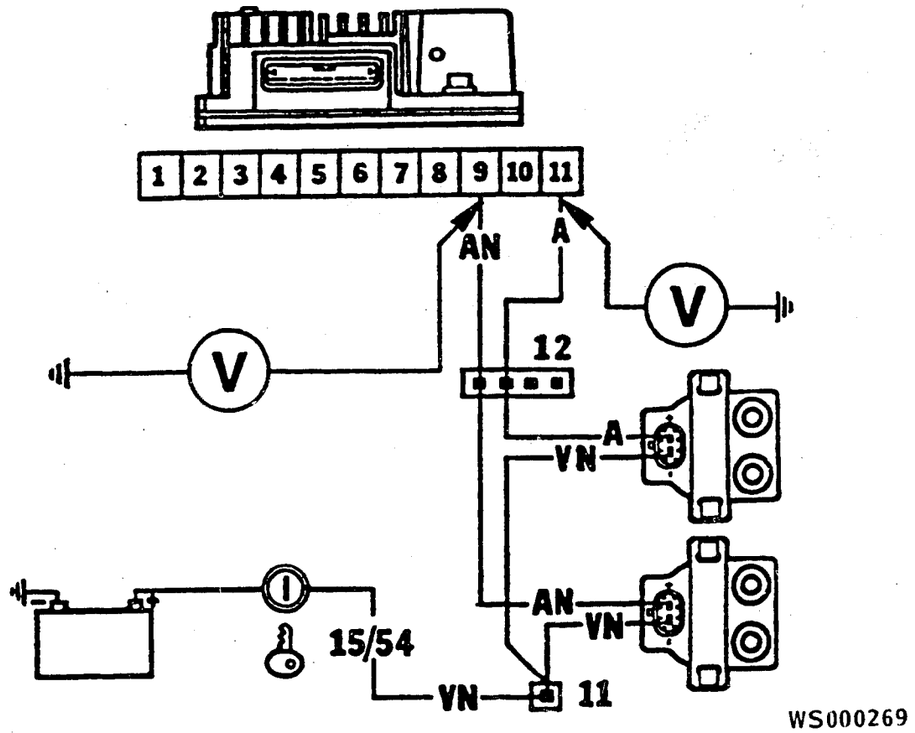
If this is not the case, the TDC/engine-speed sensor is to be replaced after checking that the terminals are not oxidized.



c) Voltage supply of control unit

With the ignition switched on, the voltage is to be checked with a voltmeter between terminal 6 and ground at the detached control-unit plug.

If battery voltage is not found, the connecting leads and plugs from terminal 6 to the connection at the ignition switch (15/54) must be checked for open-circuit/contact resistance (top picture).



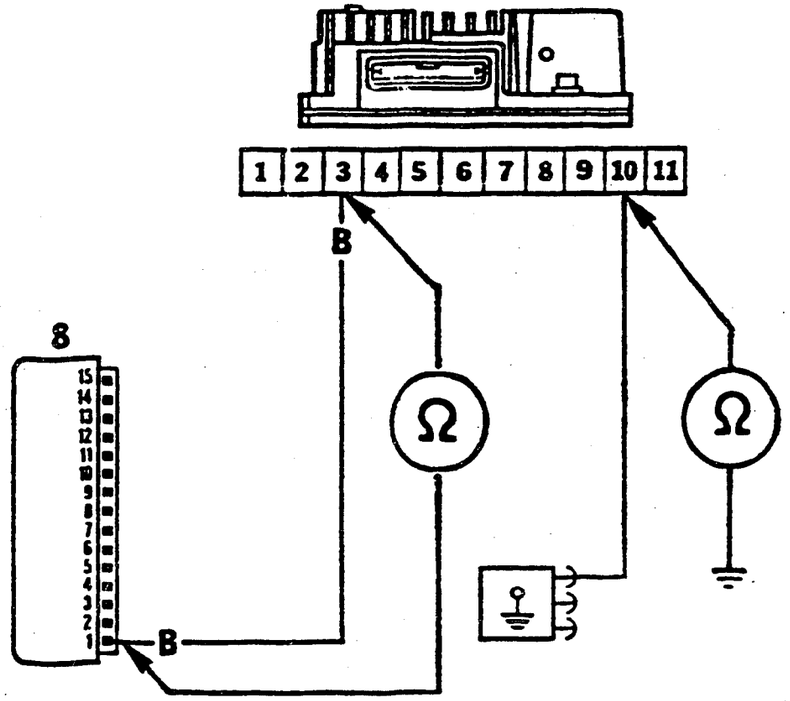
d) Check voltage supply of ignition coils/ignition control unit

A voltmeter is to be connected up between terminal 9 and ground and the voltage measured with the ignition switched on.

The same procedure is likewise to be employed between terminal 11 and ground.

Battery voltage must be found in both cases.

If not, check connecting leads and plugs for open-circuit and oxidation (top picture).



WS000270

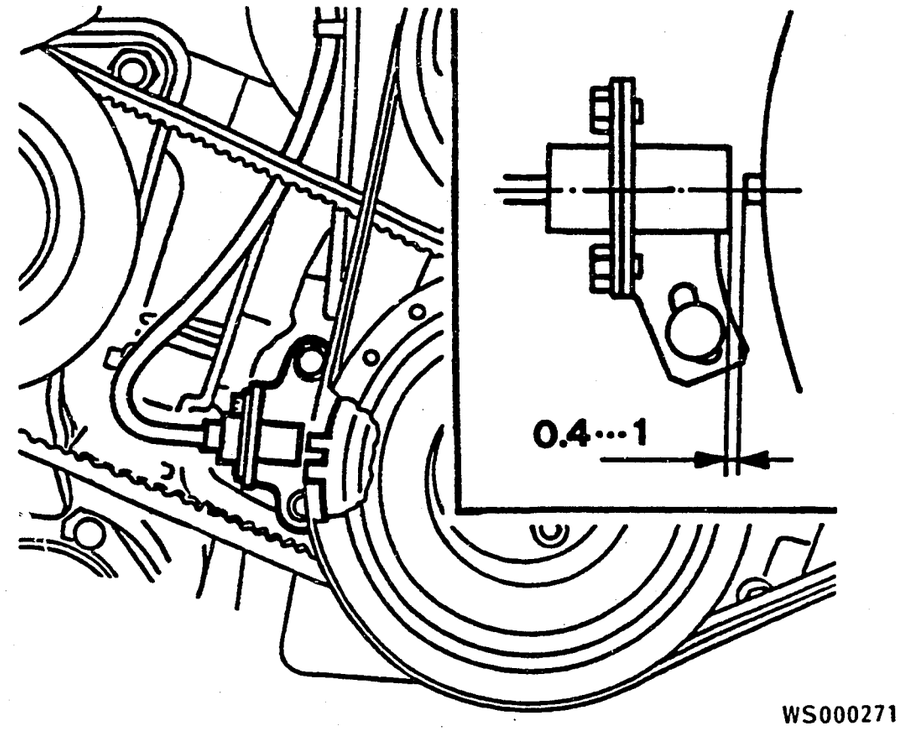
e) Checking ground lead and engine-speed signal line

With ignition switched off, an ohmmeter is to be used to check the ground connection from terminal 10 to vehicle ground (central ground).

The resistance should be 0 ohms (see top picture).

With the ignition again switched off, a check is to be made with an ohmmeter on the continuity of the engine-speed signal line from terminal 3 of the ignition control unit to terminal 1 of the injection control unit.

Set value = infinity ohms.

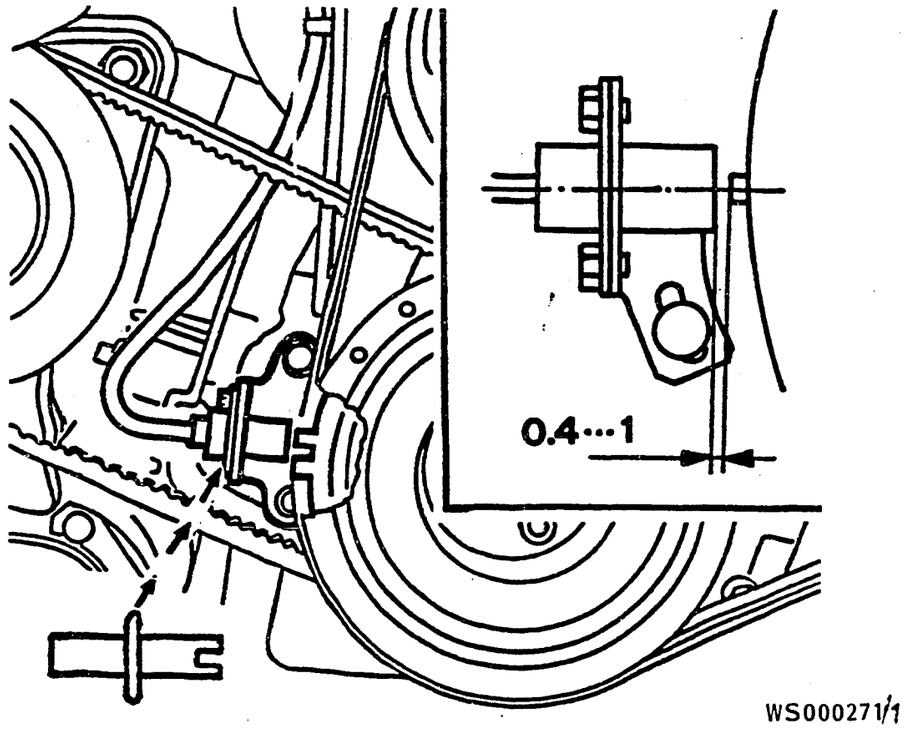


WS000271

f) Checking air gap at TDC/engine-speed sensor

The air gap between the protruding lugs of the pulse-generator plate behind the crankshaft V-belt sprocket and the engine-speed sensor must be 0.4...1.0 mm (top picture).

If this is not the case, the position of the engine-speed sensor is to be reset.



WS000271/1

g) Setting of TDC/engine-speed sensor and ignition point

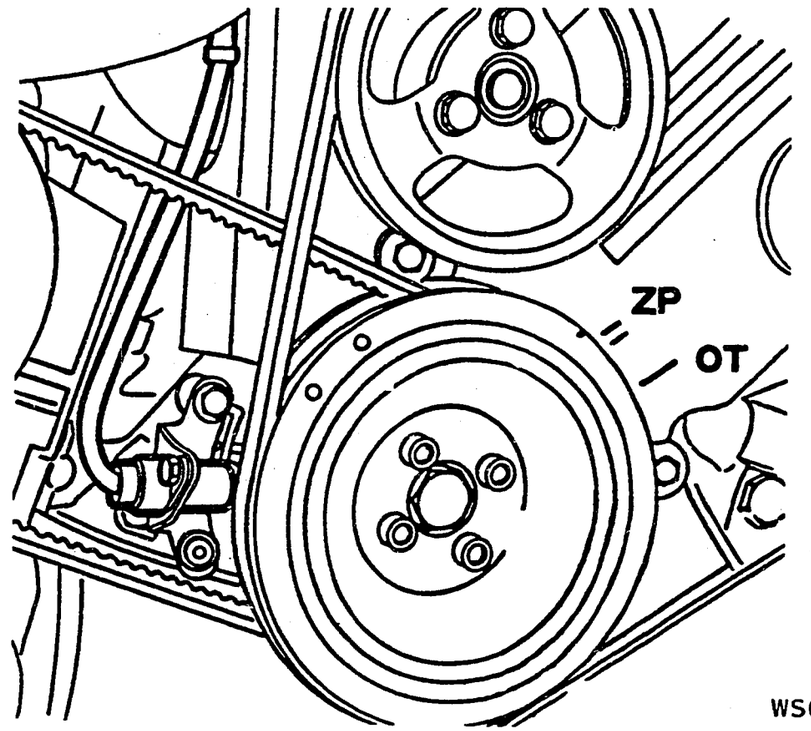
There is a special tool for this purpose (1 895 900 000).

Precision adjustment even without a special tool is possible by performing several checks with a timing light.

The ignition point is set by positioning the piston of cylinder No. 1 precisely at TDC with an appropriate gauge.

At TDC, the setting tool (top picture, left) is inserted in place of the TDC sensor into its retaining plate and aligned exactly with the first of the two double lugs after loosening the fastening screws.

Re-insert TDC sensor and check air gap again. Screw on TDC sensor and retaining plate.



WS000272

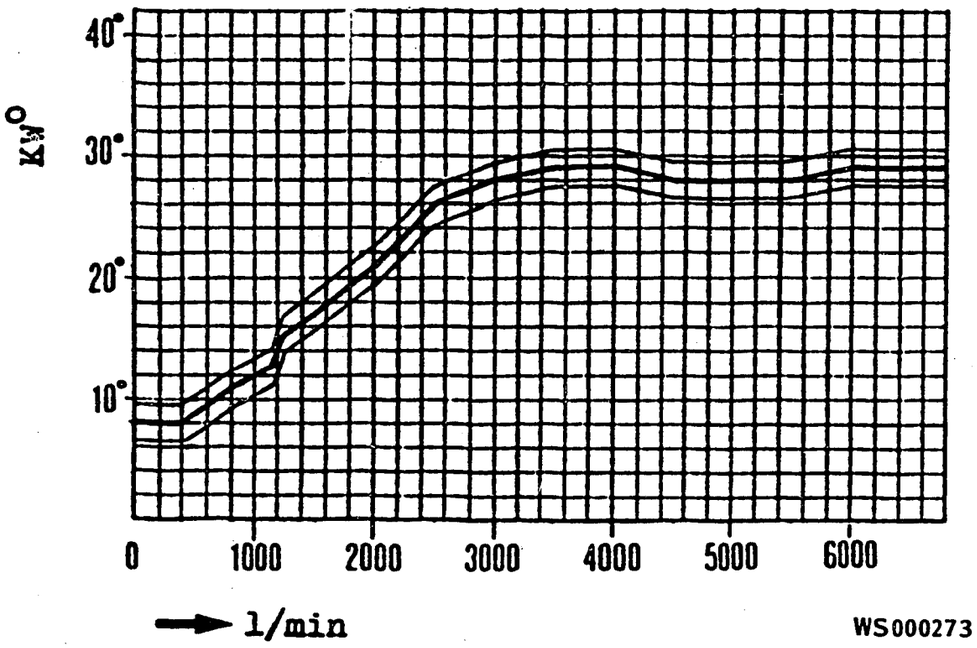
TDC and ignition-point marks on crankshaft V-belt sprocket

h) Checking advance

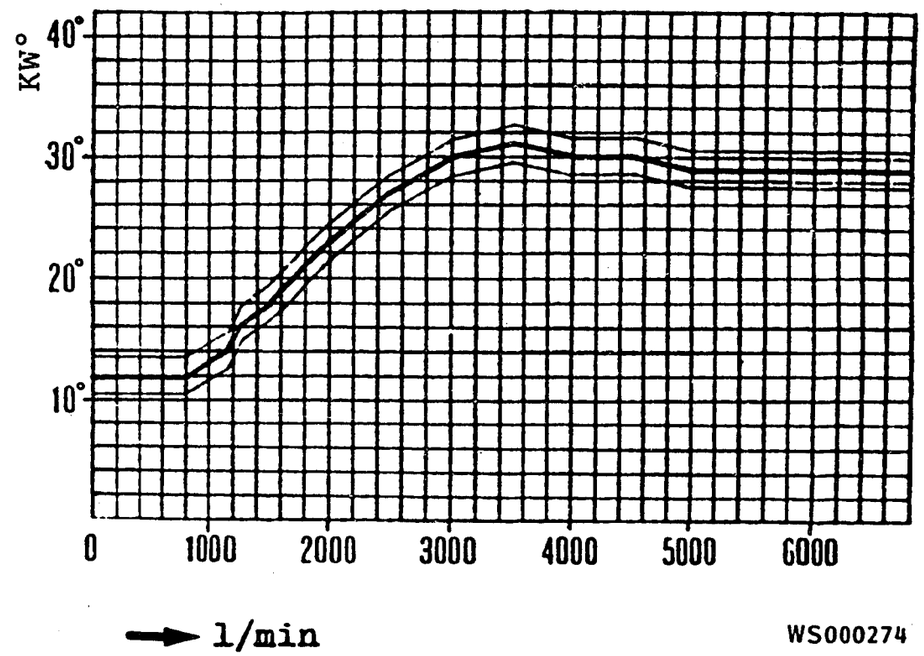
Required for this purpose are a timing light, a rev counter and a vacuum gauge which is connected by way of a T-piece to the intake manifold.

The ignition point at 850 ± 50 min-1 (idle) is 17° before TDC.

The speed-dependent advance values can be checked as a function of the different vacuums on the basis of the 8 advance graphs.

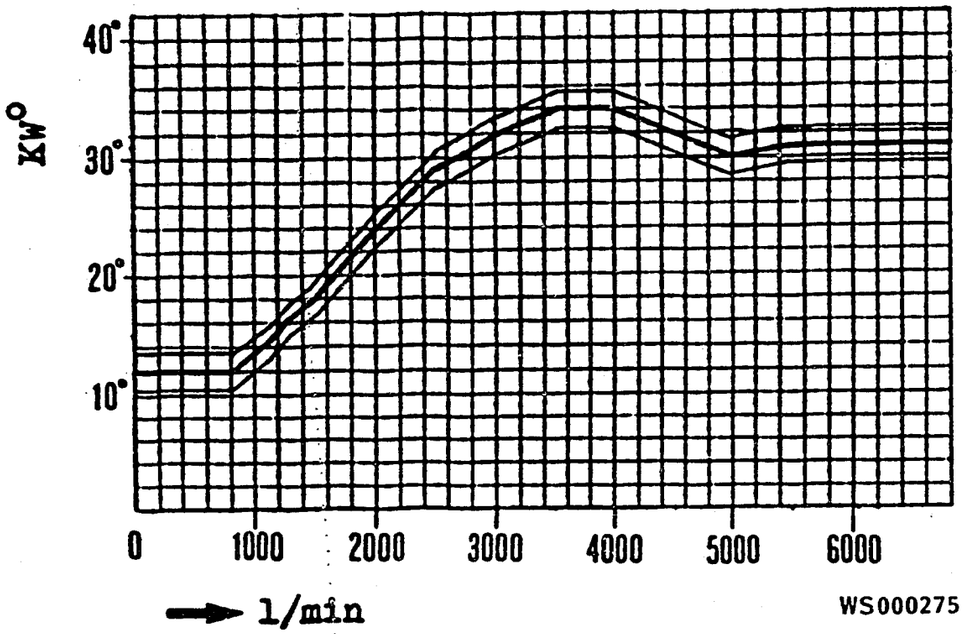


Advance curve at 47 mbar

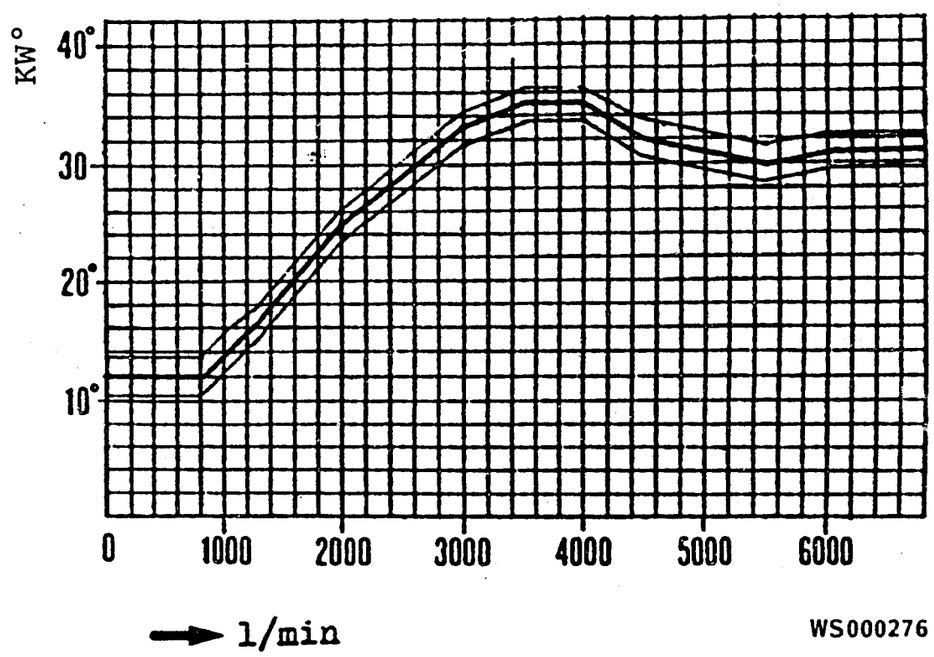


Advance curve at 140 mbar

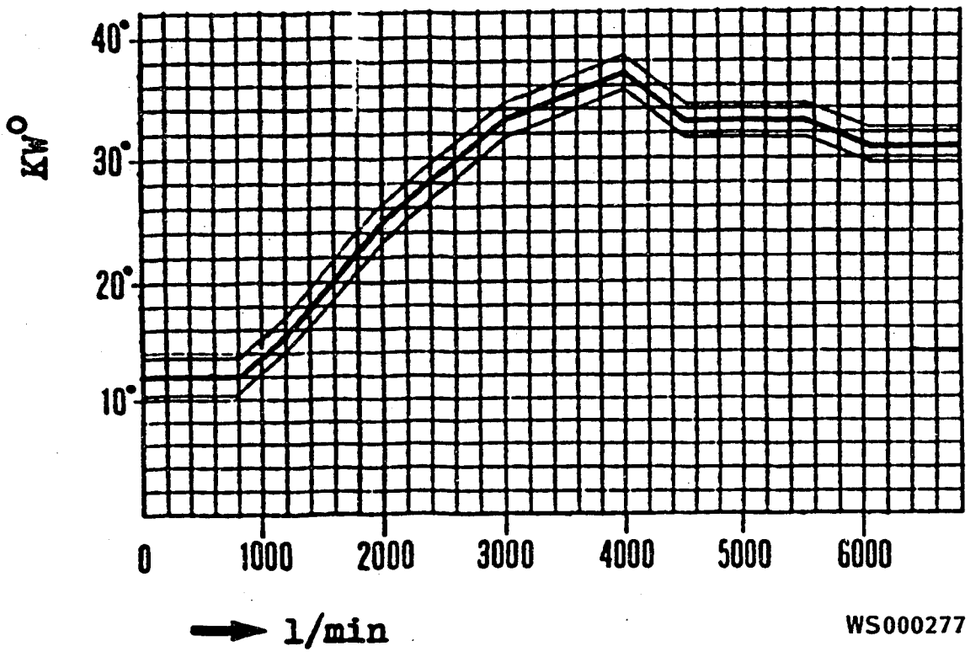
5. ADVANCE GRAPHS



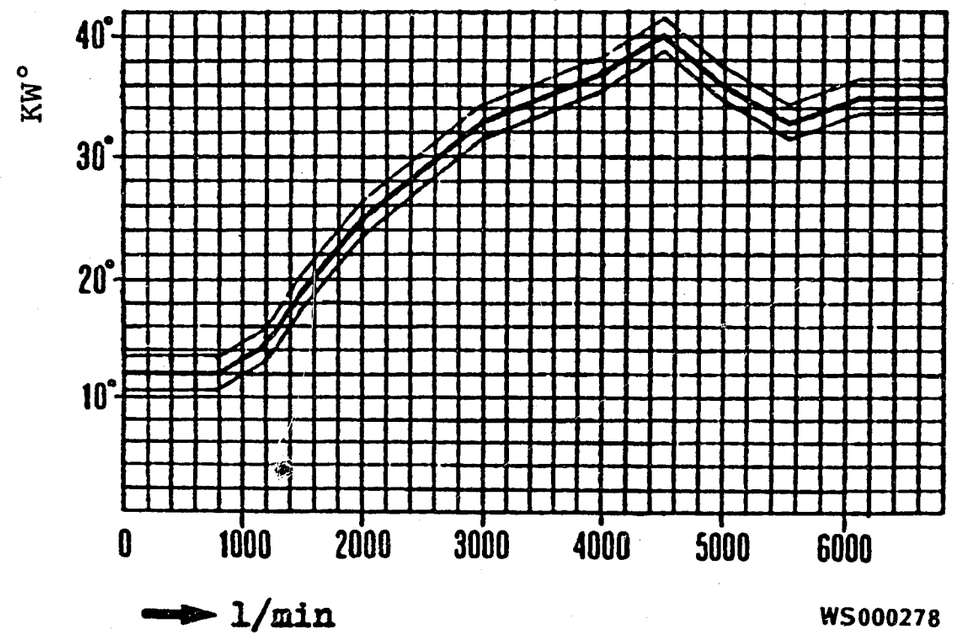
Advance curve at 233 mbar



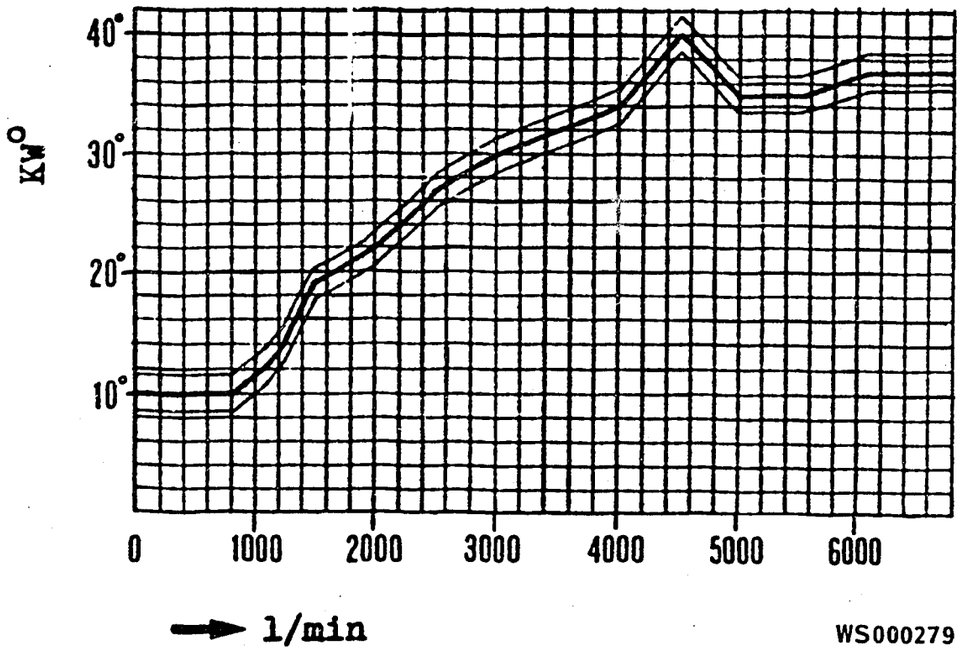
Advance curve at 327 mbar



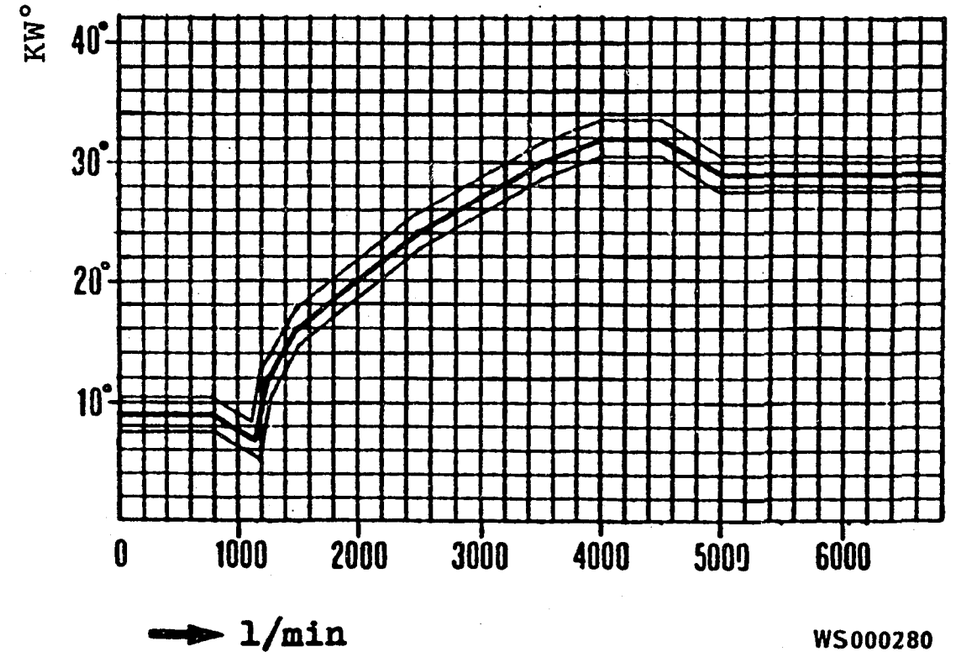
Advance curve at 420 mbar



Advance curve at 513 mbar



Advance curve at 607 mbar



Advance curve at 700 mbar

TECHNICAL DATA

Engine	Type	2000ie 16 V
	Power (kW)	104/6000 min-1
Ignition system	Make	Magneti Marelli
	Type	Digiplex 2
	Firing order	1 - 3 - 4 - 2
	Cylinder No.1	at toothed-belt drive
Spark plugs	Make/Type	Bosch WR 6 DC
	Electrode gap	0.6 ... 0.7 mm
Ignition coil	Make	Magneti Marelli
	Type	BAE 800 AK
	Primary resistance	0.50...0.60 ohms at 20°C
	Secondary resistance	6.66...8.14 kohms at 20°C
Ignition point		17° before TDC at 850 ± 50 min-1
Idling speed		850 ± 50 min-1
TDC/engine-speed sensor	Air gap	0.4...1.0 mm
	Resistance	672...748 ohms

This microcard was prepared exclusively for Bosch Service on behalf of ROBERT BOSCH GMBH STUTTGART

J. Pfyl-Ing. HTL
Ingenieurbüro für Auto-Technik

Drawn up on the basis of a publication by the same author which appeared in the "Auto-Technik" magazine published by the AT-Fachschriftenverlag AG, CH-5001 Aarau.

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LANCIA THEMA 8.32

The Thema, which is equipped with the Ferrari V-8 engine F 105 L, makes use of a Microplex ignition system from Magneti Marelli with two ignition distributors (one each per cylinder bank), two H.T. ignition coils with output stage (power module) and an electronic control unit.

This control unit receives its information from an engine-speed and a TDC sensor, both of which are located on the clutch housing and are somewhat difficult to reach.

The control unit positioned in the engine compartment determines the ignition point on the basis of a map stored in the unit and then actuates the power module.

The Microplex control supplies the fuel-injection control unit with engine-speed signals via the terminal (TD) at the engine-speed relay/fuel relay.

1. Testers

A special Fiat-Lancia tester, which can also be used for other models from this manufacturer, is available for testing the Microplex ignition.

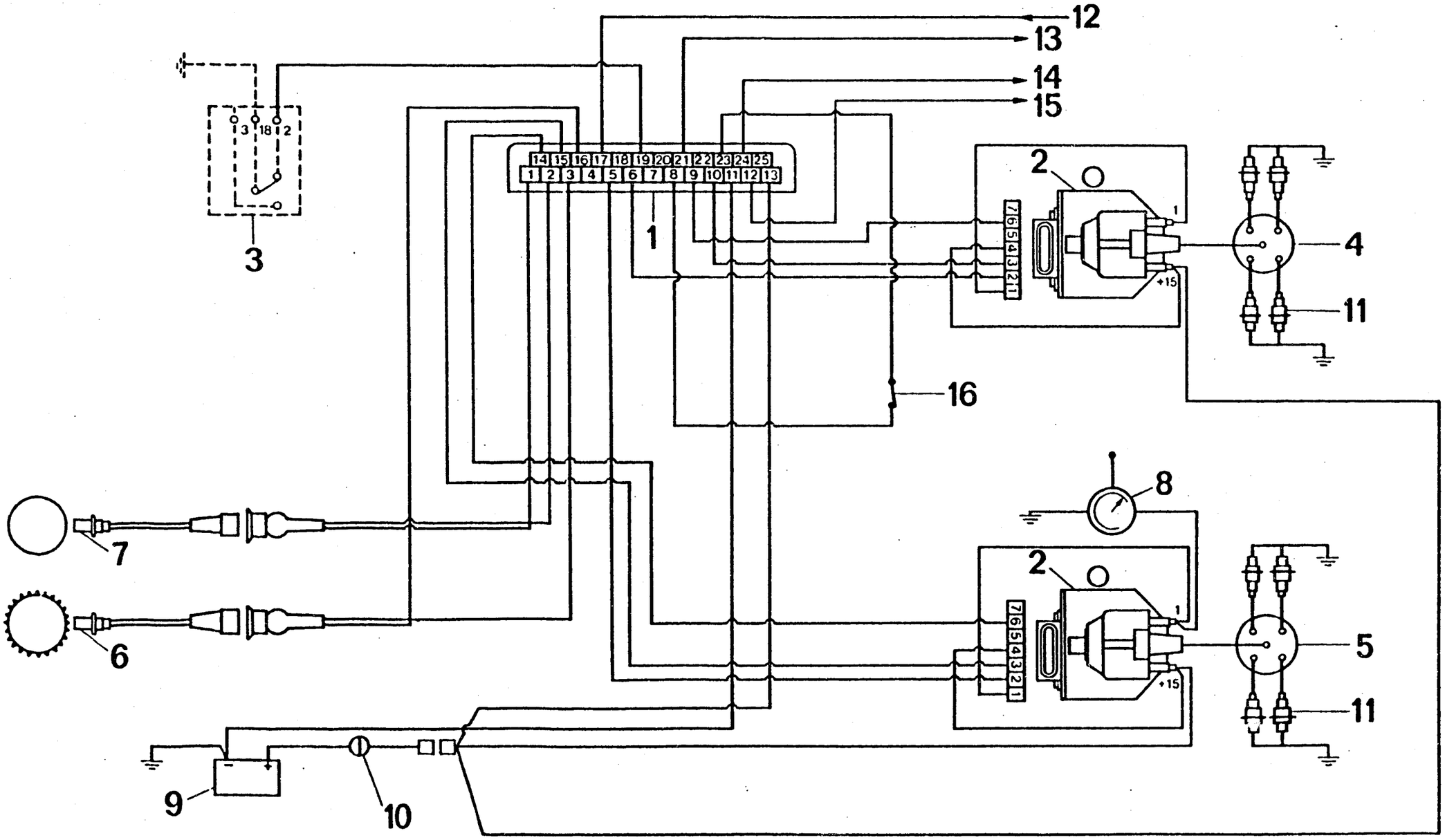
Testing can however also be performed with a voltmeter and ohmmeter, a timing light, a rev counter, a vacuum gauge and a vacuum pump.

2. Safety precautions

- Never disconnect battery with engine running.
- Never start engine with fast charger.
- Disconnect battery from vehicle electrical system when effecting fast charging.
- Remove control units at stoving temperatures in excess of 80°C following re-painting.
- Disconnect battery before performing electric welding work.
- Neither pull out insert control-unit plug with ignition switched on.

Important:

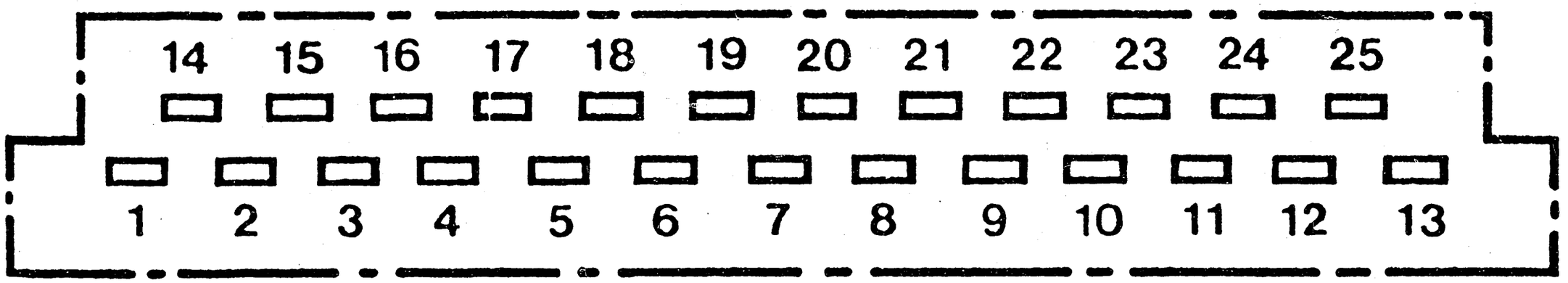
In view of the fact that misfiring can soon lead to catalytic-converter damage, in particular the H.T. part of the ignition system is to be subjected to regular checks (spark plugs, oxidized contacts, H.T. cable).



WS000281

WIRING DIAGRAM OF MICROPLEX IGNITION SYSTEM

1 = Control unit
2 = Ignition module with ignition coil
3 = Throttle-valve switch
4 = H.T. distributor for cyl. 8-2-3-5
5 = H.T. distributor for cyl. 1-4-7-6
6 = Engine-speed sensor
7 = TDC sensor
8 = Rev counter
9 = Battery
10 = Ignition switch
11 = Spark plugs
12 = Input, diagnosis tap
13 = Signal to diagnosis plug
14 = to injection control unit
15 = Ground
16 = Switch



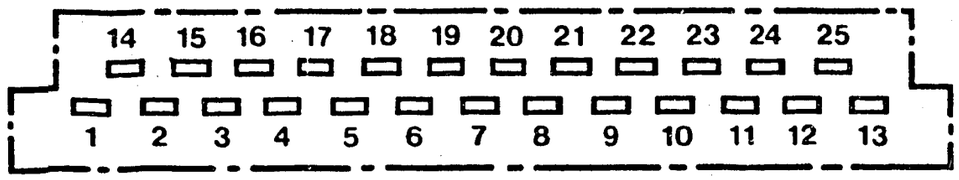
WS000283

CONNECTOR AT CONTROL UNIT

1 = TDC sensor
2 = Ground, TDC sensor
3 = Ground, engine-speed sensor
4 = Input signal 2
5 = Ground, power module 1
6 = Ground, power module 2
7 = Input module 1
8 = Input module 3
9 = Control, power module 2
10 = Ground, power module 2
11 = Ground lead to battery
12 = to tester connection
13 = Battery + to ignition lock
14 = Control, power module 1
15 = Ground, power module 1
16 = Engine-speed sensor
17 = Diagnosis tap for tester
18 = Input signal 1
19 = Input, overrun
21 = to tester connection
22 = Signal, pressure-deviation sensor (not used with Cat)
23 = Input signal 3
24 = Signal to fuel-injection control unit
20/25 = not used

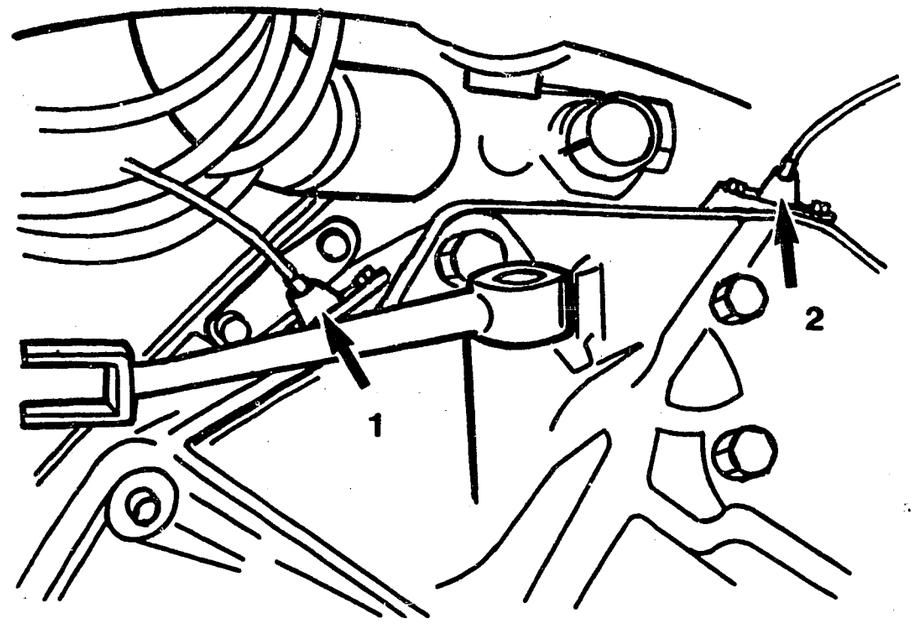
H05 —— <⟹>

H06 —— <⟹>



WS000283

Connector at control unit



WS000285

Position of sensors at flywheel
1 = TDC sensor
2 = Engine-speed sensor

3. TESTING OF INDIVIDUAL COMPONENTS

a) Testing of engine-speed and TDC sensor.

With control-unit plug pulled out, a resistance measurement can be taken for the engine-speed sensor between terminals 3 and 16 (top picture) and for the TDC sensor between terminals 1 and 2. The resistance must be 612...748 ohms in each case.

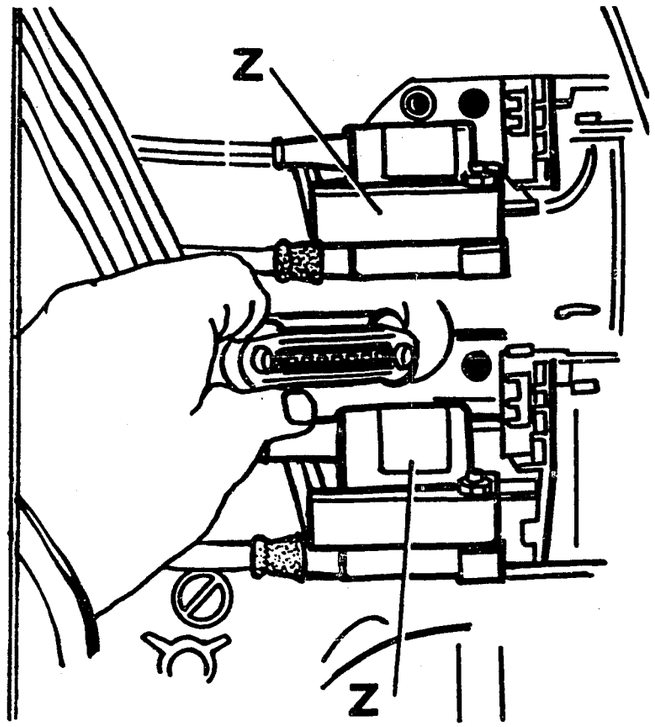
If not, the intermediate plug is to be checked and the sensor replaced in the event of a defect.

Access to the two sensors (top picture) is problematic and only possible following disassembly of the front ignition distributor.
The same applies to testing of the distance between sensor and pulse-generator ring, which should be 0.25...1.3 mm in the case of the engine-speed sensor and 0.40...1.00 mm in the case of the TDC sensor.

b) Voltage supply of control unit can be measured with ignition switched on at pulled-out plug between terminal 13 (+) and terminal 11 (ground).

Set value: Battery voltage

If applicable, plug connections and ground connections are to be checked.



WS000286

c) Voltage supply of trigger box and ignition coils:

The two ignition units are to be checked separately.

With the ignition switched on, a voltage of 12 V (battery voltage) must be applied between terminal 4 and ground at the detached plug of the trigger box. The same is true of terminal 15 of the ignition coil.

If this is not the case, check plug connections and leads to ignition lock and battery.

The voltmeter is also to be connected up between terminals 4 and 2.

If no battery voltage is applied, check plug connections and leads to control unit.
Furthermore, the ground lead from terminal 11 of the control unit to the battery is to be checked for continuity.

d) Ignition-coil resistances:

Measure primary and secondary resistance at both ignition coils.

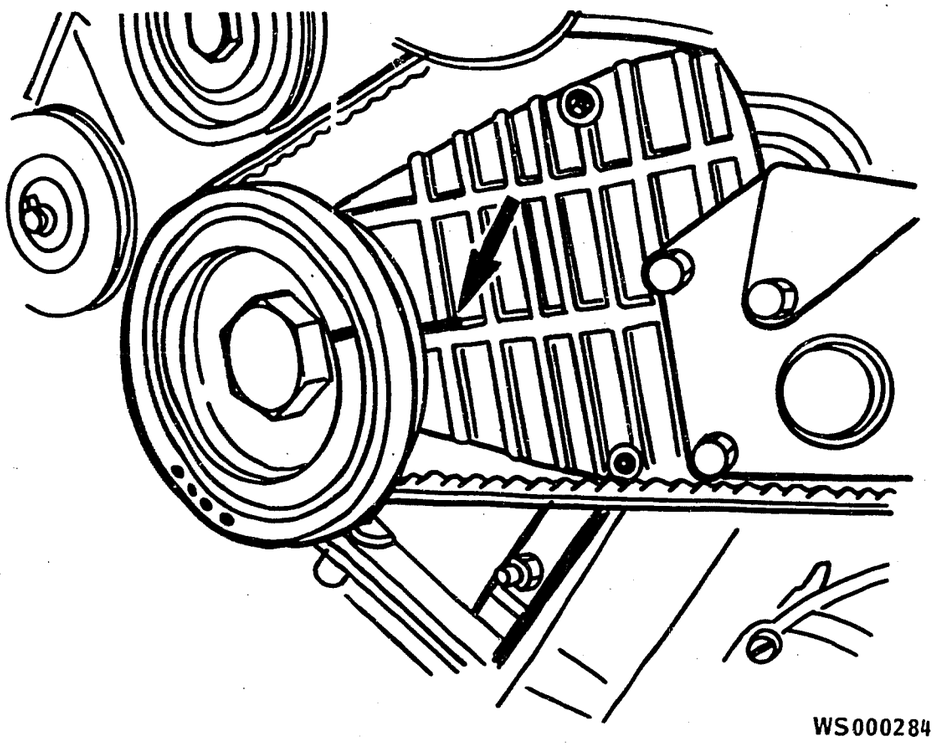
Set values:

Primary resistance (term. 15 and term. 1)
0.404...0.495 ohms

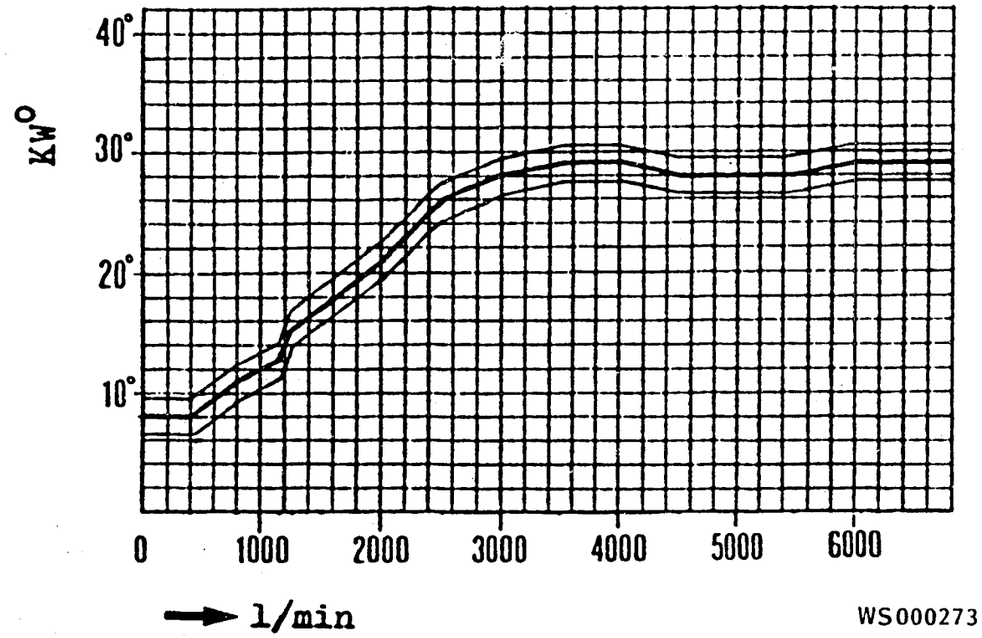
Secondary resistance (term. 15 and term. 4 = H.T. output
4.32...5.28 kohms

e) Control units and trigger boxes are only to be replaced after checking all of the peripherals. In doing so, just one trigger box is to be initially replaced.

Above all the H.T. contact points must be checked for oxidation or erosion on the non-adjustable ignition distributors.



Position of ignition marks on V-belt sprocket and casing cover



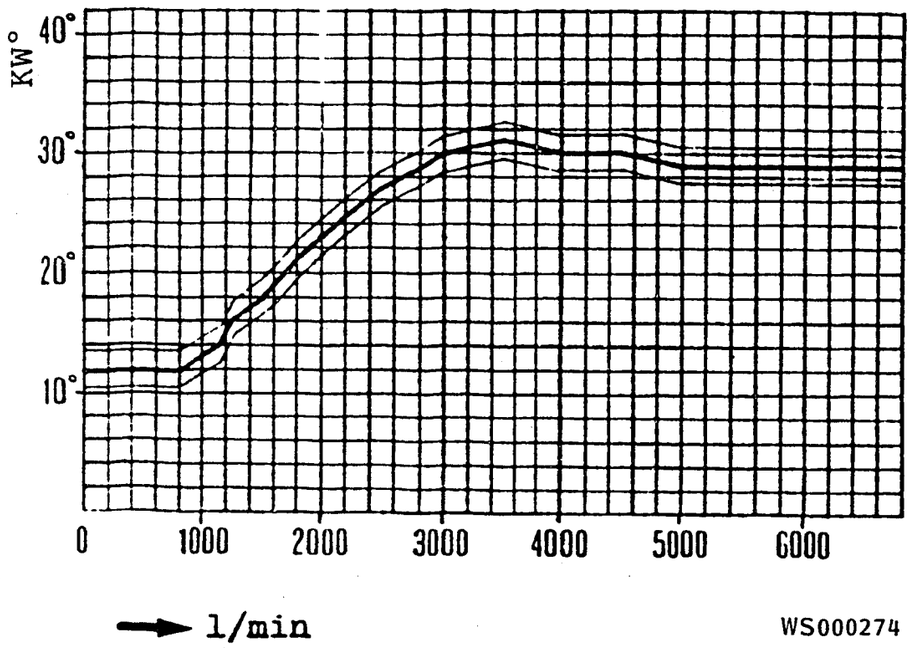
Advance curve at 47 mbar

3. Testing of individual components

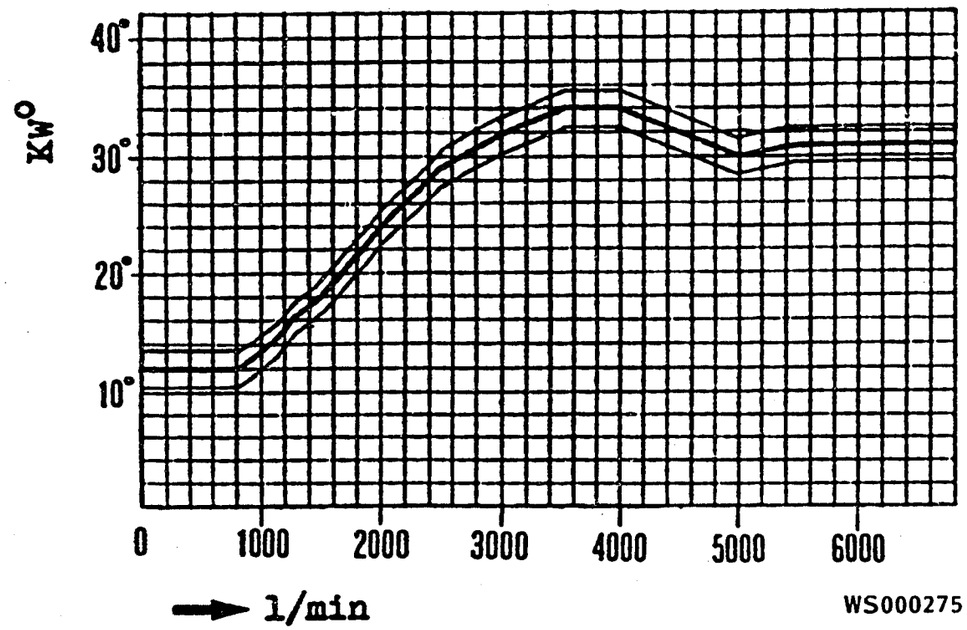
f) The ignition point and advance at different engine speeds and intake-manifold vacuum values can be checked with a timing light on the basis of the marks on the crankshaft V-belt sprocket and casing cover (top picture), and compared to the advance graphs.

The marks are only accessible from the underside of the engine and should be extended with chalk marks before testing.

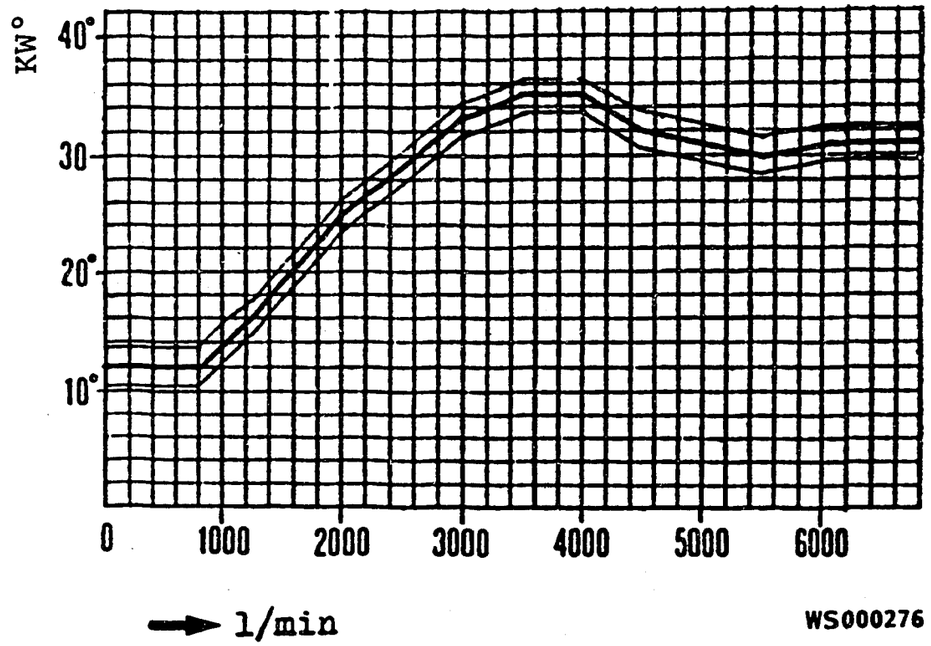
Set values for basic adjustment: 10 ± 1.5° before TDC



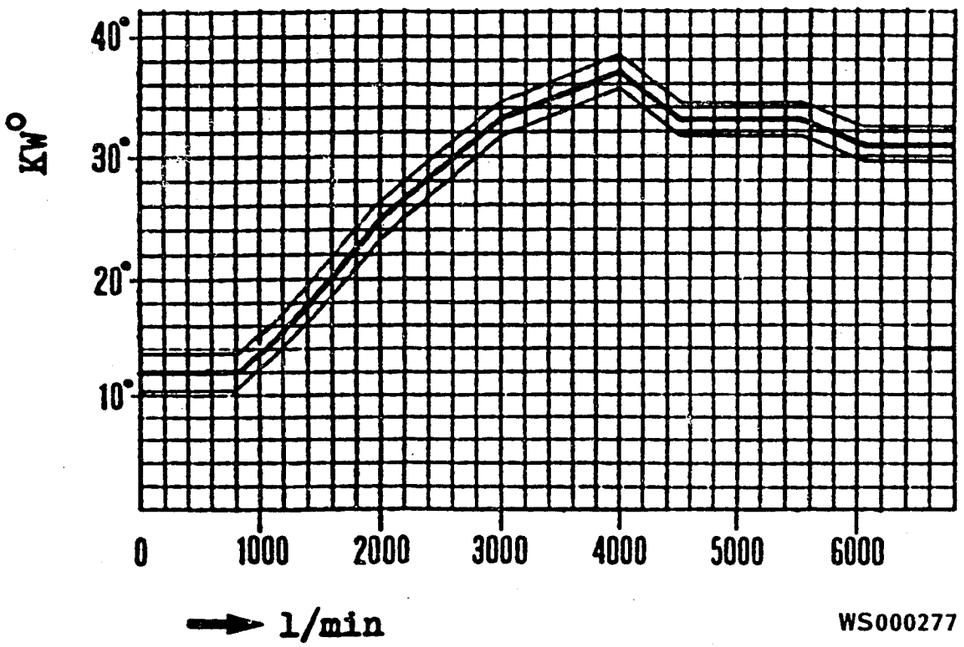
Advance curve at 140 mbar



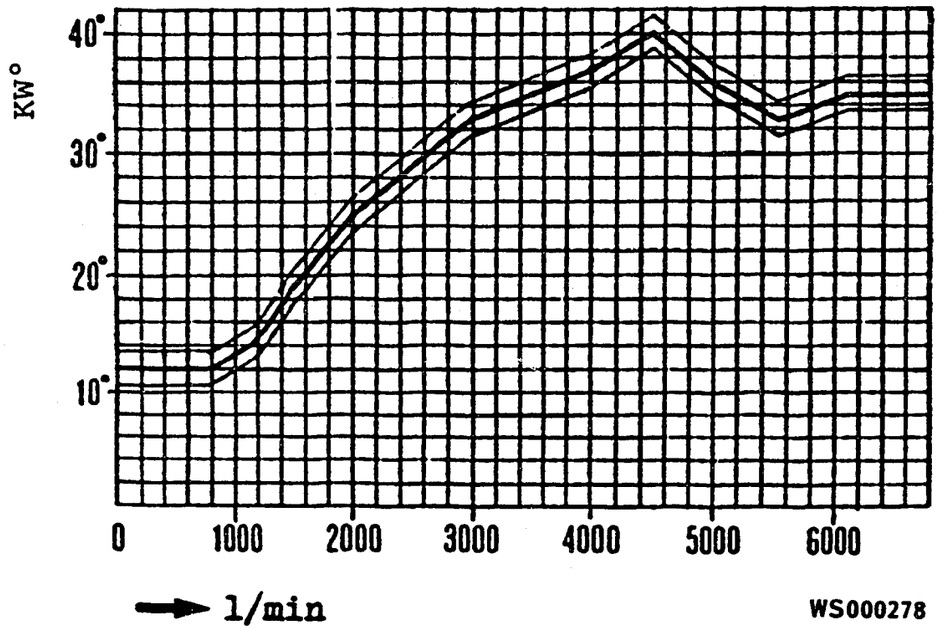
Advance curve at 233 mbar



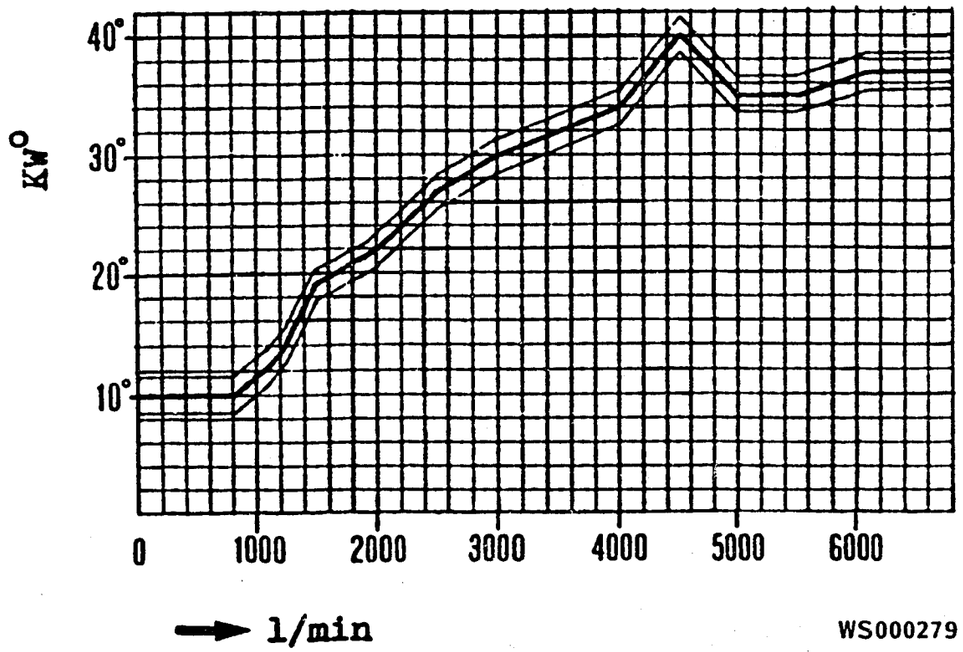
Advance curve at 327 mbar



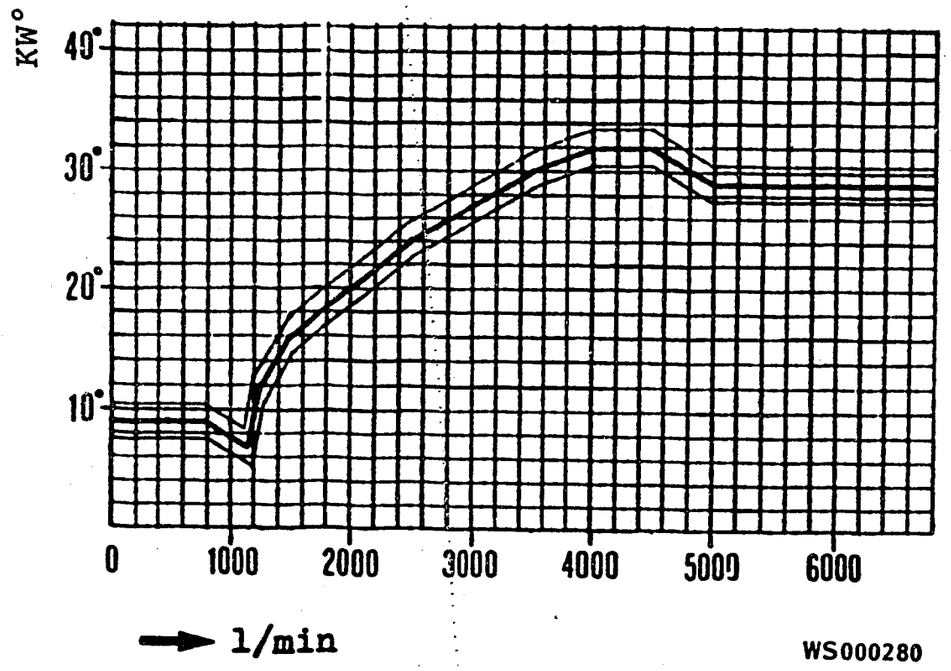
Advance curve at 420 mbar



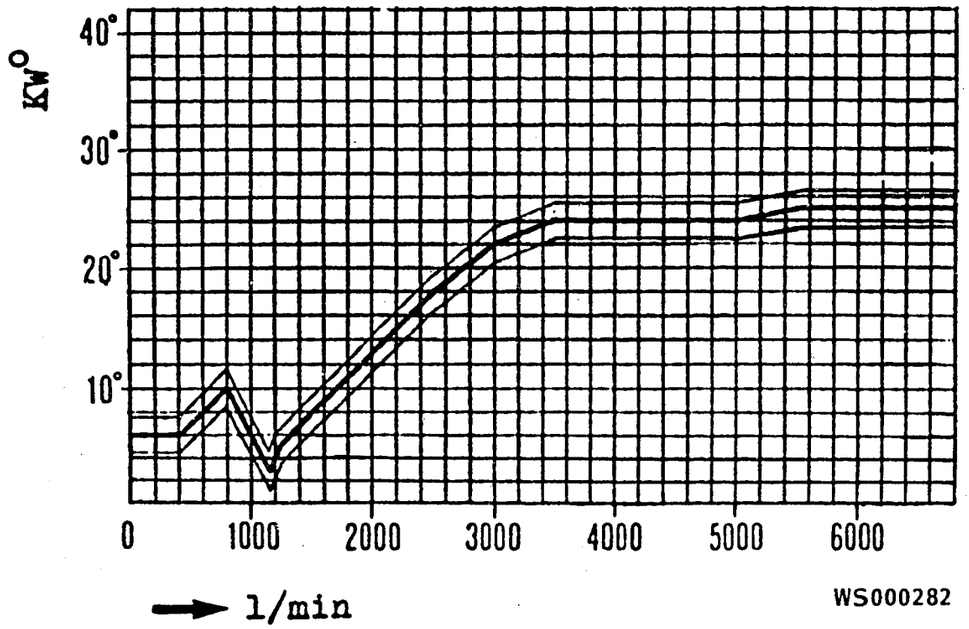
Advance curve at 513 mbar



Advance curve at 607 mbar



Advance curve at 700 mbar



Advance curve during overrun with throttle valve closed

TECHNICAL DATA

Engine	Type	F105L.046
	Power (kW)	150.5 at 6750 min-1
	Torque (Nm)	263 at 5000 min-1
Ignition system	Make	Magneti Marelli
	Type	Microplex MED 821 A
	Firing order	1-8-4-2-7-3-6-5
	Cylinder No. 1	at flywheel
Spark plugs	Make/Type	Champion A6G A6YC
	Electrode gap	0.60...0.80 mm
Ignition coil	Make	Magneti Marelli
	Type	BAE 504 DK
	Primary resistance	0.404...0.495 ohms at 20° C
	Secondary resistance	4.32...5.28 kohms at 20° C
Ignition point	at idle (920 min-1)	8 ± 1.5° before TDC
	in starting phase	10 ± 1.5° before TDC
	max. advance at 0.7 bar between 2500...4400 min-1	38 ± 1.5° before TDC
Pulse generator	Engine-speed sensor	Marelli SEN 8 E (gray)
	Resistance	612...748 ohms
	Distance between sensor and flywheel	0.25...1.3 mm
	TDC sensor	Marelli SEN 8 E (black)
	Resistance	612...748 ohms
	Distance between sensor and signal-generator ring at flywheel	0.40...1.00 mm

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